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NEW WATERWORKS EXTENSION IN GLASGOW.

By J. A. STEWART.

GLASGOW, the city of municipal enterprise, is at present engaged in an interesting extension of its waterworks system, at a cost of $5,000,000, the causes and provisions of which are of more than local or passing importance.

The necessity for extending the works has been brought about chiefly by two causes—first, the rapid increase of the population, and second, the disappointment in the flow of the first Loch Katrine aqueduct.

In 1853, when the Loch Katrine Waterworks were being planned, the population of Glasgow and suburbs was 360,000. On a basis of the census returns of 20 years previous (an increase of population averaging 7,000 per annum) it was thought that 8,000 per annum might safely be assumed as an average rate of increase for the following half century. But the population gained in a much more rapid ratio, and the quantity consumed per head rose from 40 to 50 gallons per day in addition, with the result that 30,000,000 gallons supply per day were required by 1872, instead of at the end of the century as anticipated. The increase in individual consumption, it is stated, is chiefly due to the greater number of ornamental and drinking fountains, of public bathing establishments, of modern conveniences in homes of the artisans, and of hot water for heating purposes.

The failure of the original aqueduct to carry the amount primarily designed was attributed to the fact that no allowance had been made in the calculations for frictional resistance from inequalities in the rock cuttings.

As a new aqueduct was necessary, it was resolved to apply to Parliament for power to duplicate the whole works and to design them for an ultimate supply to the city of 100,000,000 gallons per day.

As Lock Katrine and sister lochs furnish large quantities of water, a source of supply was at hand. The hills about are all of the same geological character and they all yield water of equal purity. Loch Katrine, too, as stated by Mr. James Gale, chief engineer, is the lowest in level of the whole series of lochs, including Loch Lubnaig, so that the additional water can all be discharged into it, and before passing into other districts it was wisely desired to make the most of the sources already preëmpted by the city, besides of those in the immediate vicinity which naturally flow into the valley of the Clyde.

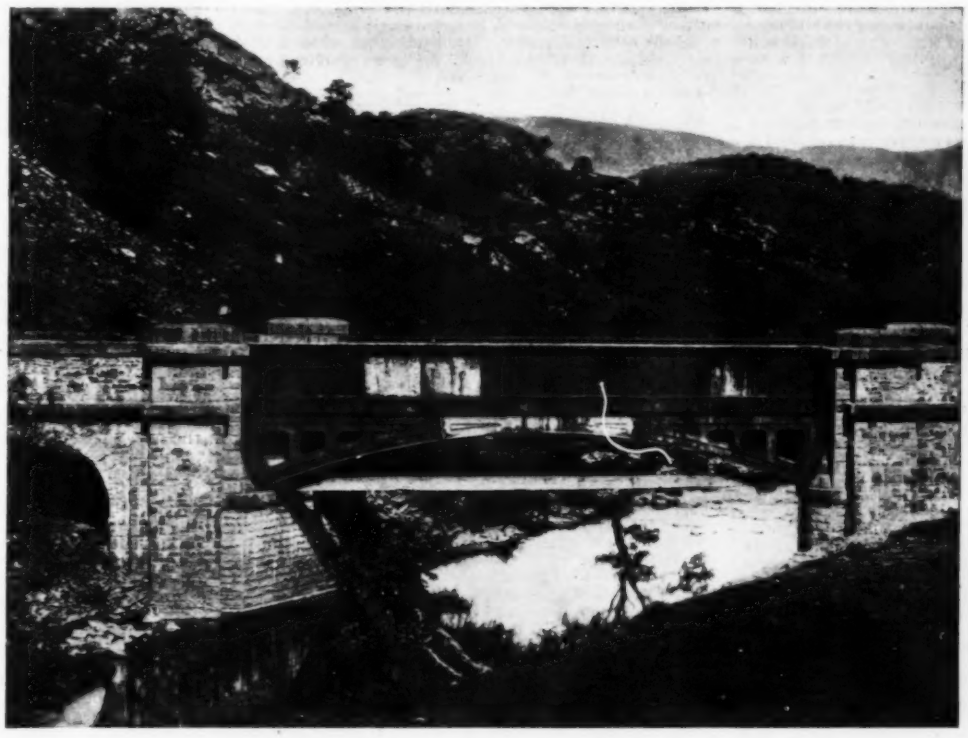
The present operations in extension consequently include, first, a new aqueduct and additional lines of mains from the service reservoir to the city; second, the raising of the present high-water level of Loch Katrine 5 feet, by which its output is increased to 65,000,000 gallons per day; and third, the conversion of Loch Arklet, which flows into Loch Lamond, into a service reservoir, by raising it 25 feet in level; by which a further supply of 10,000,000 gallons a day can be secured. The additional 25,000,000 gallons is to come from the River Leny.

Instead of following the old line, the new aqueduct is diverted to avoid the broken and irregular ground in the vicinity of the Duchray water. It is about 23 miles long, consists of a series of tunnels, and is divided into seven sections, the Loch Katrine inlet and tunnel, the Loch Chon section, Duchray and Kelty diversion, Black Rig diversion, Endrick Japing, Blane Valley section, and Mugdock tunnel. For the first 9½ miles from Loch Katrine, the aqueduct passes through the metamorphosed mica schist of the lower Silurian system; then follows red sandstone and conglomerate for about 5 miles. The Blane Valley section passes for its whole length through the calciferous sandstone series, consisting of soft red and white sandstone with beds of shale; and, lastly, the Mugdock tunnel, through a mass of whinstone and volcanic ash. All the tunnels in the Silurian, whinstone and old red sandstone were worked by compressed air and rock drills. The explosive used was chiefly gelaguite. The bottom of the aqueduct has a concrete invert throughout its whole length. Its walls are 3 feet thick.

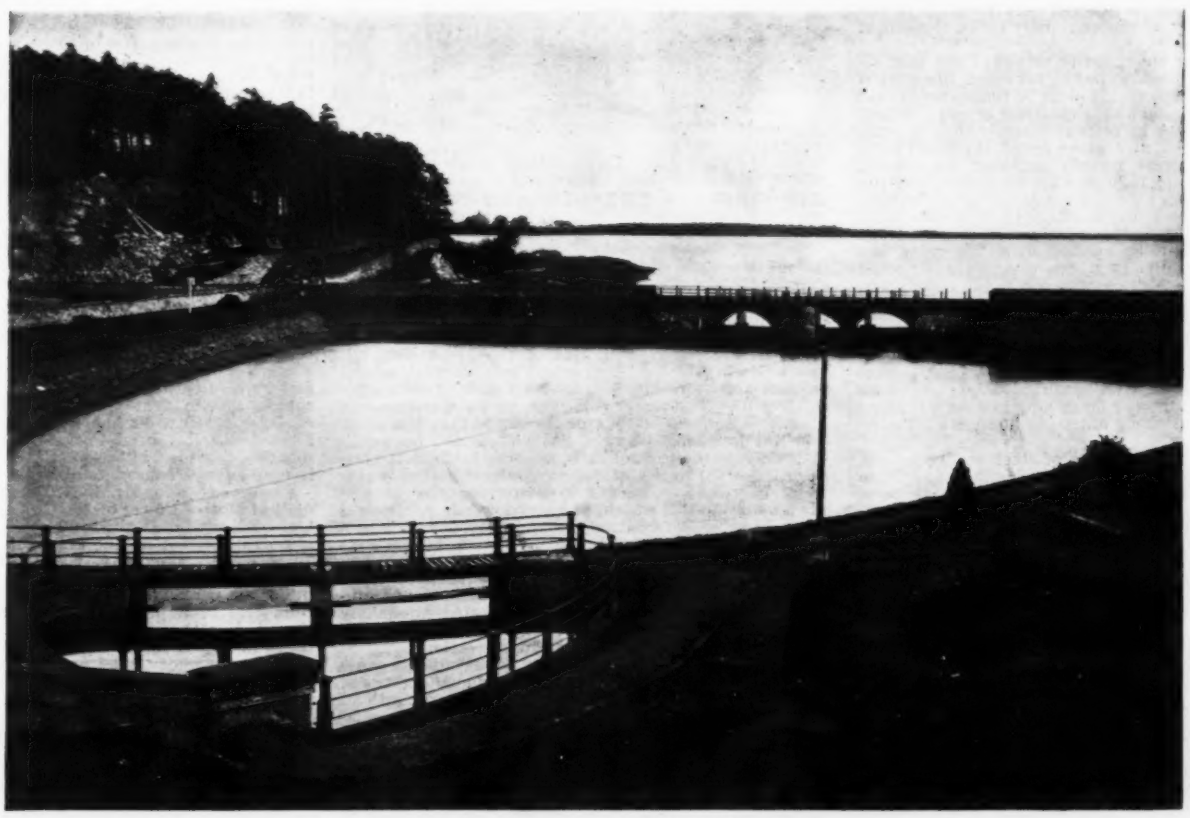
The new aqueduct has been kept underground as much as possible. There are only five short bridges on the whole line, of the type shown in the illustration. Air spaces extend the whole length of the exposed part of the bridges, and drains are so constructed that any leakage from the aqueduct may be detected at once. By this arrangement it is expected that the influence of frost and the heat of the sun will be prevented from reaching the water channel within the bridges.

The inverted siphon pipes which carry the water across the Endrick and Blane Valleys are important features of the works. They are each 12 feet long, and the 48 inch pipes weigh from 3 to 4½ tons each. All the siphon and other large pipes are jointed with mild steel collar joints 6 inches long, hollowed out ¼ inch inside to assist in holding the lead, which is caulked up on the two external faces as well as in the space between the two pipes.

To complete the duplication of the works it was necessary to have an additional service



DUCHRAY BRIDGE—GLASGOW WATERWORKS.



CRAIGMADDIE RESERVOIR—GLASGOW WATERWORKS EXTENSION.

reservoir near the city. The new reservoir has a water surface of 86¼ acres, an available depth of water for the city of 40 feet and will contain a maximum of 700,000,000 gallons. It is crescent in form and connects at its west end with the adjacent Mugdock reservoir.

The digging of the trench for the new reservoir has lasted six years, and has proved to be a most difficult and expensive piece of work, the chief hindrance being the great depth and the amount of water encountered. The total cost of this work reached $370,000, an excess of $100,000 above the estimate.

The plans for the works at Loch Katrine, as has been stated, have involved the raising of the loch level 5 feet. Some lines of new highway had to be constructed to take the place of submerged roads, new steamboat piers erected, and so on. The works at Lock Arklet consist of an embankment across the valley, a discharge tunnel at the lower or Loch Lamond end, and a tunnel about 700 yards long at the upper end, by which the water will be drawn into Loch Katrine.

The conservation of the purity of the Glasgow water supply has not been neglected. The associations which Scott has thrown about the shores of the Scottish sod have made it doubly attractive as a place of residence and summer resort, consequently the commissioners by payments amounting to $85,000 have deemed it wise to permit the further erection of any buildings within the watersheds of the locks—an area of over 26,000 acres—or the increase of steamer traffic beyond tourists' requirements. With the same object in view, of preserving the purity of their water supply, the municipalities of Liverpool, Manchester and Birmingham have, at great cost, purchased outright the whole area of their respective watersheds; but it is conceived that nearly all the advantages to be secured through purchase will be enjoyed by Glasgow through the prohibition of fencing or renting houses.

[Continued from SUPPLEMENT, No. 1284, page 20581.]

IRON AND STEEL RAILS IN AMERICA.*

By ROBERT W. HUNT, M. Am. Soc. C. E.

STEEL rails, when first manufactured, replaced iron rails, which, through their deteriorated quality and the increased duty demanded of them, were giving most unsatisfactory service. Some of the early steel rails failed, but most of them were so much better than the best of their predecessors that such failures did not excite adverse comment. They were of what would now be considered light sections, and thus in their production from the 6 inch by 6 inch or 7 inch by 7 inch blooms from which they had been rolled, had received much work, and at a comparatively low temperature. In the writer's judgment the greatest factors in the production of good rails are covered by the words "work and temperature." All steel men know that work at high heats does not change the grain of steel at all in proportion to work given at lower temperatures.

For years after the introduction of steel rails a 65-pound per yard section was considered a heavy one. In fact, in America it was the heaviest used, and much the largest percentage was not over 60 pounds. These were rolled from 7 inch by 7 inch blooms. The ingots from which the blooms were made were generally 12-inch by 12-inch. After the bloom was formed it was examined carefully after becoming cold, and all cracks and mechanical imperfections were chipped out. Then, after slow heating, with care to avoid too high a temperature, the blooms were rolled into rails by light reductions. While this was being done, if a defect showed itself, the process was stopped until it was chipped out. Now, this slow work at a moderate and steadily decreasing temperature, resulted in a fine grained metal, which, of necessity, no matter what may have been its chemical composition, would give greater resistance to the wear of traffic than could be possible from the coarser grained steel which is in the head of the heavier and more rapidly rolled sections of to-day.

By waiting long enough, the things of the past always become the best. That is, provided the past is not examined too closely. It must be remembered that the early rails replaced a much inferior article; in fact, created a revolution in railway maintenance of way. Hence, if a few from any cause failed, it excited little comment; they were quietly replaced by others. After a while these failures were forgotten, and the whole lot of existing rails was instanced as an example of what rails should be. Another thing which must not be overlooked is, that the early steel rails had the ultimate stress of traffic applied by slow degrees. In other words, the traffic to which they were subjected when first put in service was for them light duty. Heavier rolling stock, faster and more frequent trains, came gradually. The old-time rails, which are in these later days so reverently mentioned, had been subjected to a cold-rolling process before being given their severest task. To-day an 80-pound is hardly cold before a 175,000-pound locomotive, hauling 100,000 pounds capacity cars at 35 miles per hour, and limited expresses of heavy Pullmans at 60 miles per hour, are thundering over it.

The details of manufacture of steel rails changed, not only in America, but also in England and other countries. This had to be, and it would to-day be as impossible to return to the earlier methods as to restore the service of stage coaches.

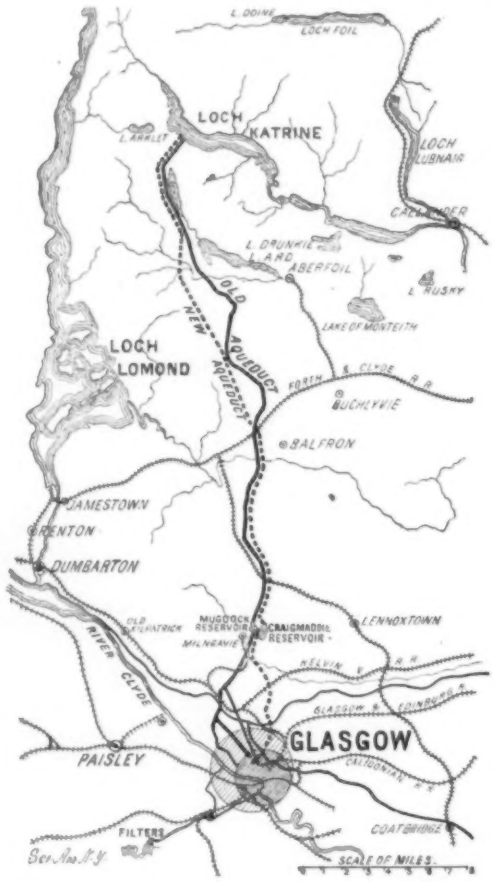
In 1876 the writer presented a paper at the Philadelphia meeting of the American Institute of Mining Engineers on "The History of the Bessemer Process in America," and with great pride chronicled the fact that the North Chicago Bessemer Works, under the management of Robert Forsyth, had, in a single month, produced 6,457 gross tons of ingots, and that it led the world's records. These ingots were all rolled into rails. To-day the North Chicago Converting Works and rail mill are abandoned, their places having been taken by the present South Chicago plant of the Illinois Steel Company, in which rail mill the largest month's production has been 58,103 gross tons of standard-sectioned rails.

The Edgar Thomson Works of the Carnegie Steel Company has made 47,074 gross tons of rails in a calendar month. Other American mills are turning out a large tonnage, but it is believed that the foregoing at present hold the record.

While the faster work of modern practice has somewhat altered the character of the steel in rails, it must not be assumed that the product has been increased without any regard to other considerations. This is not true; on the contrary, the outward character or finish of the rails has been improved to a radical extent. While working fast, the improved machinery is also reliable, and the care exercised in keeping true to section, square sawing, accurate drilling, and straightening of both line and surface, yield results which it would have been impossible to obtain in the earlier days. In fact, the requirements of the railways, in consequence of increased weight and speed of traffic, etc., have made it imperative that such finished rails should be given them.

It is not desired to draw any invidious comparisons, but in the writer's judgment American makers are to-day not only turning out the most rails, but at the same time the best finished ones now produced. Moreover, foreign rails imported into the United States and Canada during late years have not worn any better than American rails.

It has been stated that examining into the past sometimes disprove assumptions. So that, while in the earlier days rail steel and rails were made with all the time and care which has been described, all the rails produced were not satisfactory. In fact, the experience of the Pennsylvania Railroad was such that their chemist, Charles B. Dudley, M. Am. Soc. C.E., made an elaborate investigation into the chemical composition of their satisfactory and unsatisfactory rails. His deductions were presented to the American Institute of Mining Engineers, in October, 1878, and elicited a memorable discussion. Dr. Dudley concluded that rail steel could be too hard for good service, even



MAP SHOWING THE OLD AND NEW AQUEDUCTS OF THE GLASGOW WATER SUPPLY.

though the rails did not actually break. His conclusions were in favor of chemically softer metal. Some of those discussing the matter thought and stated that the size of the rail sections should not be ignored.

As the accredited authority of the great Pennsylvania Railroad, Dr. Dudley's views carried added weight, and it resulted in a demand in America for softer rails. The writer thinks that no one to-day will attempt a defense of that position. In fact, the practice did not long prevail. But it cannot be safely claimed that the present rails, whether made in America or imported from Europe, are giving absolutely satisfactory results. They are permitting the accomplishment of work which, but a little while ago, would have been considered an impossibility. Still, if engineers had ever been absolutely satisfied with that which was, progress would have halted. Heavy-sectioned rails which will yield better results than those now being obtained are needed. Our railway organizations have generally become so situated financially that they need no longer be limited to the immediate present in the policies of their administrations.

In the old countries, railroads were built because there was a population whose needs demanded them. In this country they were often built because there was a tremendous amount of country and no population. This led to cheap construction; but while we still have plenty of room for more people, our country has become rich enough to justify the best of railroads, and, in fact, imperatively demands them. The successful operations of the roads themselves can be only on such a basis. As the railroads increased in number, and their requirements varied in accordance with their traffic and profiles, and being constructed and operated by many different men, it was natural that not only the weight of rails used, but their sections, should differ. In fact, almost every road had its own particular section. The variations between many were slight, but sufficient to necessitate the use of special rolls in their manufacture. This had become so pronounced and caused so great an investment of capital on the part of rail makers and loss of time in changing from one section to another, etc., that Mr. Holley, in his characteristic progressive spirit, attacked the situation in a paper presented to the American Institute of Mining Engineers, in February, 1881. In this he stated that, answering his inquiries, the eleven Bessemer mills then making rails in the United States had sent him drawings of 188 patterns which were considered standard ones, and that 119 patterns of 27 different weights per yard were regularly manufactured. Mr. Holley gave drawings of many of these, and pointed out the absurdity of some of the variations. His paper attracted wide interest, but it was a difficult matter to reach. However, its discussion was continued by others later. Mr. P. H. Dudley, who had devoted much time to the study of the wear of rails, and who invented a recording car for the examination of the rails, contributed papers on the subject to both the scientific press and societies. Mr. Hawks, M. Am. Soc. C.E., then chief engineer of the Michigan Central Railroad, advocated certain sections, as also did D. J. Whittemore, past-president Am. Soc. C.E.; and the writer also presented a series of sections in a paper read before the American Institute of Mining Engineers, February, 1899.

This Society appointed the committee on "The Proper Relation to Each Other of the Sections of Railway Wheels and Rails," which performed its duties in a thorough manner; and following and resulting from its reports, the Society appointed a committee to consider and recommend a series of standard rail sections. This was in 1891, but the final report of the committee was not made until June, 1893.* During the intervening years the members of the committee had worked faithfully; consulted personally and by correspondence with many of the chief engineers of the railroad systems of the country, and agreed upon all points but one. One member, Mr. George S. Morison, differed with the chairman, Mr. G. Bouscaren, and with Messrs. Foster Crowell, Virgil G. Bogue, S. M. Felton, J. D. Hawks, E. T. D. Myers, Samuel Rea, Thomas Rodd, A. M. Wellington, F. M. Wilder, and Robert W. Hunt, as to the width of heads of the proposed sections, and on that point made a minority report.

As secretary of the committee during the latter part of its work, the writer knows the difficulties and labors of the task; and naturally is gratified to know that the recommended rail sections are to-day practically the standard ones for American railroads. During 1899 quite 75 per cent. of all the rails rolled by American rail mills were of what are commercially known as the American Society sections.

Geographical and commercial conditions must govern. When the Bessemer process was first introduced in America imported English pig irons were used in making the steel. American irons were experimented with, and gradually displaced foreign irons. This practice first prevailed in the works located west of the Allegheny Mountains. They soon relied entirely upon charcoal pig, made from Lake Superior and Missouri ores. This was much higher in phosphorus than the English irons, but the results obtained from it were so satisfactory that the investigation continued and extended to the use of American mineral fuel irons, both anthracite and coke. After a time these completely displaced both foreign coke and American charcoal brands, in both Western and Eastern works.

It happened that, while the most available Western ores contained percentages of phosphorus fully up to the limit possible for Bessemer uses, the cheapest Eastern ores were quite low in that obnoxious element. Hence, it has been and is a fact, that some of the rail makers located east of the Alleghenies can produce rails low in phosphorus contents, while using the lowest priced pig metal. The opposite is true of the Western mills. These geographical and commercial conditions have led to the use of entirely distinct chemical specifications in the two districts—at least, by some of the leading makers in those districts.

The heavier equipments and higher speeds required more rigid road beds, which could only be obtained by heavier sectioned rails. These were gradually adopted. It was naturally expected that as the sections were increased so would the resulting amount of service yielded by the rails. From the very first, the results obtained were disappointing, and the writer doubts whether we will ever succeed in getting results as satisfactory as those yielded by the lighter sections. As the area of the section is increased, so, of necessity, will the work upon the steel in forming it be decreased; and as the resulting mass is enlarged, so will the amount of heat retained in it at the time of the final reduction through the rolls be increased. In the writer's judgment it will be found that the most satisfactory results will be obtained by so modifying the rolling system that the final pass (or better passes) shall be given after the temperature of the partially formed rail has been lowered. This is not by any means a new idea, but as yet it has not been carried out in a manner calculated to obtain the best results.

Some years ago, Mr. F. A. Delano, now Superintendent of Motive Power of the Chicago, Burlington, and Quincy Railroad, in the interest of that company, had some rails rolled at the South Works of the present Illinois Steel Company, then owned by the North Chicago Rolling Mill Company, on such lines and under his personal supervision. Unfortunately, these rails were of a peculiar section, which was not continued, but the writer believes that the wear of the metal itself was encouraging.

The satisfactory wear being given by rails renewed by the "McKenna Process" at the Joliet and Kansas City Mills of the McKenna Steel Working Company, bears very strongly on this point. Mr. McKenna takes rails which have become unfit for further service in main line tracks, from having become rough in surface, through flow of metal, or other causes; or which have become curve-worn on the side of the head; and, after carefully removing any fins which have been formed on the upper edges of the heads by metal flow, charges

* Read before the American Society of Civil Engineers, London meeting.

* Transactions, Am. Soc. C.E., vol. xxviii.

them into a long furnace, and, when heated to not more than 1,500° Fahr., they are drawn from the furnace by a mechanical contrivance which at the same time removes any scale which may have formed on their surface, and slightly upsets or flattens the section. The rail is then passed through a set of forming rolls, from which it is carried forward to another set, in which it is given a finishing pass. The rail is then sawed hot, and cold-straightened and drilled in the usual manner. And while the section has been somewhat reduced, the original flushing sections and heights have been maintained.

Now, the steel has been given finishing work at low temperature, and examination has proven that the grain of the metal in the head of the rails has been "fined." But, more important than all, the wear of the renewed rails is promising to be much more satisfactory than that obtained from new rails of heavier sections. This treatment of rails is no longer in an experimental state, as it is over five years old, and there are nearly 100,000 tons of renewed rails in service on the Chicago, Milwaukee, and St. Paul; Atchison, Topeka, and Santa Fé; Wabash, and other large systems. One chief engineer, on whose road there are many of these rails, says: "No rail ought to be used at all until after it has been renewed."

The writer has already stated that, owing to geographical, and hence commercial, conditions the chemical specifications under which rails are made differ east and west of the Allegheny Mountains. In the Scranton and Bethlehem District what are known as the New York Central and Hudson River Railroad specifications, which were originally formulated for that road by Mr. P. H. Dudley, are regarded as the standard; while for the mills west of the Alleghenies a different formula is followed. Some of the main railway systems insist on buying under their own chemical specifications, no matter where made.

The writer has gone on record so often, as believing that in the absence of work at low heats, incident to the present method of making heavy-sectioned rails, it is important to increase the carbon with the section to as great an extent as the phosphorus present will permit, without incurring risk from breakage, that it seems unnecessary to repeat the arguments.

At the Atlanta meeting of the American Institute of Mining Engineers, in October, 1895, the writer presented a set of specifications for "Steel Rails of Heavy Sections Manufactured West of the Alleghenies." In accordance with these specifications thousands of tons have been made and used with satisfactory results. During the last two years the Western makers have declined to limit the phosphorus to less than 0·10 per cent., but, in fact, have been making steel with a fraction less than that amount, say, 0·09 to 0·096 per cent. And he regrets to say that in many cases they insist that the amount of carbon shall be less than that which he has advocated. He believes, however, that gradually higher carbon will prevail; and, certainly, has not had any cause to change his mind on the subject. His experience as a steel-rail maker, and as an observer of the wear of steel rails of many sections and diverse chemical composition, leads him to advocate: 1. Work, after careful heating of the steel, and continued until its temperature has been much reduced. 2. That the carbon percentages shall be increased in proportion to the increase of rail section, the ultimate amount being of necessity limited by the contained percentage of phosphorus. In all cases he advocates the use of drop tests, on samples from each heat of steel.

At present many of the American railway engineers use the drop test, but none of them demands the static or tensile tests insisted upon by so many engineers of other countries; nor does the writer think there is any necessity for these latter. The chemical analyses and drop tests are all-sufficient.

[Continued from SUPPLEMENT, No. 1284, page 20581.]

AMERICAN ENGINEERING COMPETITION.*

V.—ORE SUPPLIES AND TRANSPORT.

THE ports of shipment for iron ore in the Lake Superior district are mostly situated near the head of the lake. In this distant territory the handling of ore has led to the erection of some of the most advanced appliances in the world for the transmission of material in bulk—a circumstance which has had an important influence on the iron and steel industry, enabling the Americans to compete more successfully for the trade. To take the ironstone from upland deposits and place it in a ship's hold appears a very simple matter; nevertheless, there are refinements which may be observed that will make the difference between profit and no profit. Here the American mechanical engineers and ironmasters have shown ingenuity and foresight. It should be said, however, that our own blast furnaces, on the northeast coast of England or in South Wales, are well served in this respect. The ore they smelt is largely mined—if the expression may be used—from the open slopes of the Biscayan Mountains on the romantic coast of northern Spain. The ironstone there, though less rich in metal than that of America, is too hard and compact to be dug by a steam shovel, as the gravel-like deposits of the Mesaba are dug. Much of it has, therefore, to be blasted away from the mountain side; and one of the big blasts is a fine thing to watch, standing half a mile or more away on the opposite mountain side. A bugle call sounds across the gorge, and men can be seen—though but just seen, for they are stained the same color as the earth—creeping up the cliff face or stumbling across precipitous slopes to places of safety below. After an interminable minute of expectancy, a report comes through the thin mountain air; others follow, singly at first, then more frequently, until, amidst one great roar, a slice of the mountain heaves forward and falls, leaving a bright red scar where it was severed. Tons upon tons of broken ore pour down the slopes, through gullies and over terraces, in turgid veinous streams, so red is the new ferruginous earth seen in the southern sunshine. The digging of a steam shovel on the Mesaba is less picturesque, but cheaper. Still, it has a grandeur of its own, this plodding, powerful drudge that picks up five tons of earth at every stroke it takes. In Spain the ore is broken up in a steam-driven ore-crusher; and after that it is filled into railway wagons, or is slung down the valley slopes on aerial ropeways. The latter method has been carried to great perfection in Spain. The carrying-buckets, filled with the red hematite, slide along the steel threads in incredible speed, until the ore is dumped into ships lying in the blue little river below.

When the American ore arrives by railway at the lake shipping port the trucks are run onto a wooden jetty. At Duluth, which is at the head of Lake Superior—the westernmost point of the vast chain of American inland seas—there are two of these jetties, each 2,000 feet long and having four pairs of rails running from end to end. Beneath the decking of the jetties there are built into the structure two rows of ore bins, and each bin will hold from 150 to 175 tons. They have sloping bottoms, and there are sliding doors in the sides which, when raised, will allow the ore to run down into swinging spouts, by which it is directed into the ship's hold. The railway wagons are fitted with bottom doors, so that a load of twenty-five tons can be dumped into the bins, and from the bins to the ship, with no more hand labor than is needed for pulling a bolt.

All this is very simple—obvious, one might say, in its simplicity—but, to get the best results in time and labor saving, co-operation in design has been needed between the car builder, the civil engineer, and the naval architect. This is a lesson we might profit by in England. The bins or pockets in the jetties are spaced 12 feet from center to center, while the ore wagons are 24 feet long each. The hatchways of the ships are also 24 feet apart from center to center. There is, it will be seen, a hatchway of the ship corresponding to every other bin, and twelve or fourteen spouts will be lowered when the contents of that number of bins—say 2,000 tons of ore—will be immediately transferred to the ship. The vessel will then be moved ahead 12 feet, so as to take the contents of the intermediate bins, or another 2,000 tons of ore.

The automatic trimming devices, the method of marshalling the cars, the design of the cars, and the construction of the vessels have all special points which are the result of much thought, ingenuity, and co-operation among the various authorities concerned. The simplicity of the arrangement is so admirable that one is apt to think there is nothing to learn, that the thing could not be done otherwise. But engineers know how encumbered by needless suggestion is the road to simplicity, and how much that is redundant has to be discarded on the march toward what is obvious.

The Lake Superior mines are not very far from a thousand miles from Pittsburg, where the greater part of the ore is used. From Bilbao to Middlesbrough, is about 1,100 miles, while from Bilbao to Cardiff is a lesser distance than the voyage made by the ore ships from Duluth to ports on Lake Erie, where the ore is landed. From Lake Erie to Pittsburg is about 150 miles. A few miles more or less, however, do not make a great deal of difference per ton of freight in big cargo steamers when once the material is in the ship's hold, so for the minute we will suppose the ore has to be carried the same distance in America as from Spain to England. The Americans, however, labor under what, with our system, would be the enormous disadvantage of having to transship the ore twice en route. There is first a railway journey, then a steamer voyage, and then another railway journey. One might think, under such conditions, that it would be hopeless for the Americans to try to compete with us, who have one simple ocean voyage. It is these facts which make their ore handling appliances so interesting to us, for by them chiefly they have overcome the obstacles of distance and a broken journey. It must not be forgotten, however, that the American ore is richer than that of Spain, the respective percentages of iron averaging roughly as 60 to 55.

The vessels which make the voyage on the lakes are built to carry about 6,000 tons of ore, although limited in draught to a little over 16 feet. Some of them are nearly 500 feet long. It is a surprise to a good many to find such big, powerful craft used solely for navigating fresh water. They are as large as some ocean liners, but are not handsome, even when compared to the average "ocean tramp." "Whalebacks" are largely used, but this uncouth type of vessel does not appear to be so popular as it was a few years back. Having traversed 400 miles on the often stormy waters of Lake Superior—which is the biggest fresh water lake in the world, being a little larger than the Victoria Nyanza—the ore ship enters the Sault Sainte Marie Canal to be transported to Lake Huron. There are three locks here. The Canadian Lock, 900 feet long by 60 feet wide, is said to be the largest in the world. Vessels drawing as much as 18 feet have passed through. The machinery for opening and closing the lock gates is worked by electricity, the current being generated by turbines. This lock was completed five years ago and cost about three-quarters of a million sterling. The traffic through the Sault (pronounced "Soo") Locks is very large. In the winter navigation is stopped by ice, but during the 241 days on which the canal was open in 1898 no less than 21,234,664 tons of cargo passed through. This was carried by 17,161 vessels—or rather, there were that number of passages made, for many ships must have passed more than once. Of the total quantity of goods, about two-thirds was iron ore. The business done by the Sault Sainte Marie has often been compared to that of the Suez Canal, to the disadvantage of the latter. In the same year, 1898, 3,503 vessels passed through the Suez Canal, the tonnage being 9,238,603, of which 68 per cent. was British. According to this, the American canal had an enormous advantage; but it must be remembered that the Suez Canal records deal with net tonnage, which is a very different thing from the tonnage a ship will carry, there being all manner of arbitrary allowance to reduce the former. In any case, however, the traffic through the "Soo" is enormous, though chiefly of low value material.

The difference in level between Lakes Superior and Huron appears to be about 25 feet—it is variously given—and the natural stream connecting the two is of the nature of a rapid. Fifty years ago the navigation of the lakes was made continuous by the opening of the canal; previously to that any vessels ascending were drawn up an incline; large schooners up to 80 tons, and even steamers, being served in this way. The history of the progress of navigation on the great lakes is a remarkable record, and well worth separate notice, for it contains the seed of what may prove to be the greatest rivalry to our shipping supremacy that we have yet experienced.

Having traversed Lake Huron, vessels pass by the St. Clair Canal into Lake Erie, on the southern shore of which are situated the receiving ports for the Pennsylvania and Ohio iron districts. The chief in importance of these is Cleveland; near to which is Lorain, situated on a river which would not be large even for England, but is accounted no more than a creek in America. Small as it is, however, by means of dredging it has been made just big enough for the ore steamers to get up to where the Federal Steel Company have an extensive and well-equipped works, one of a number possessed by this powerful corporation. Here a semi-circular basin has been scooped out of the opposite bank in order to give room for the ships to swing.

The Federal Steel Company is one of those gigantic combinations with which Americans have lately been astonishing the industrial world. It was incorporated in September, 1898, and consolidates the Illinois Steel Company, the Minnesota Iron Company, the Duluth and Iron Range Railroad, the Elgin, Joliet and Eastern Railroad, the Lorain Steel Company, and Johnson & Company, of Pennsylvania; each one of these in itself being a large business. As it owns a "practically inexhaustible supply of the best ore in the United States," a railroad connecting its mines with Lake Superior, five docks having a storage capacity of 138,756 tons, and a large number of steamers, barges, etc., for transporting ore, it is entirely self-contained: there are no supplies of raw material from outside to sap its profits. Therefore, the whole increment of gain since the incorporation of the company should go to swell the credit side of its balance sheet, after allowing a comparatively small sum for possible advance in labor. What this profit means may be gathered from a statement of prices that ruled shortly after the consolidation compared with those of a twelvemonth later. The quotations are given in The New York Iron Age, which is the recognized authority in these matters. In November, 898, No. 2 Foundry pig iron was worth $11 per ton in Chicago; exactly a year later it was worth $13.50. At the former period Bessemer pig was worth $10.40, a year later it was $24.90. Steel rails were worth $17 a ton in 1898, and $35 in 1899. Manufactured steel, such as angle bars, plates, beams, etc., and also various other products of the company, have risen during the same period in almost, if not quite, the same ratio. The Chicago works alone of the corporation can turn out from their 17 blast furnaces considerably over a million and a half tons of pig iron a year; and this is converted into Bessemer or open-hearth steel, either as rails, bars, plates, etc. As the demand for steel has been at full stretch ever since the consolidation was made, stockholders may expect to receive a good dividend even on the $200,000,000, or roughly 40,000,000 sterling, which is the gigantic capital of the company.

The ore landing plant at Lorain, where there are two large blast furnaces, is one of the best equipped in the country. It consists of eight Brown conveyors, which take the ore from the vessel's hold and deposit it in what is called the stock-yard. These stock-yards are an essential feature of steel works depending on a lake-borne ore, because supplies are cut off throughout the winter months by the closing of ports by ice. In average years, at the beginning of the winter season, there may be 8,000,000 to 10,000,000 tons of ore laid by, but last year stocks did not appear to me to have accumulated to anything like this in most of the yards. If this were a fact, it bore testimony to the then enormous demand for steel, as every available steamer had been hard at work from the earliest day of the season. A mild November doubtless helped to replenish the stocks later on.

It is difficult to give an idea of the Brown conveyor without the aid of drawings. It is a wonderful device, and consists essentially of an enormous traveling bridge of steel, stretching over a width of about 400 feet. The piers of this bridge, also of steel, are mounted on wheels, so that the whole structure can be traversed sideways on heavy rails laid for the purpose. The bridge itself forms a railway, on which runs a trolley containing a pulley, over which, in turn, runs the steel wire rope for lifting the ore buckets. The maximum height of the bridge to the under side above ground level is 60 feet or more. The traversing, raising, and lowering and tipping of the ore bucket are all controlled from the cabin, where the mechanism is placed, the details being worked out in a very ingenious manner.

These bridges are generally used in groups, there being eight in a group at Lorain. The speed at which the trolley is traversed on the bridge and at which the bucket, holding 15 cwt. or so of ore, is raised and lowered is very great. Mr. Head gives particulars of twelve hatchways of one ship being worked by twelve bridges when 6,000 tons were taken out and deposited in twelve hours. This would be nearly eight tons per man per hour, there being eight men filling the buckets per bridge. The same authority gives the cost of unloading and putting on the stock heaps at between ¼d. and ½d. per ton. At the Illinois Steel Company's works, South Chicago, there is a magnificent unloading plant, consisting of nineteen Brown conveyors; and I was there informed that the quickest record they had made was 60 tons per hour for each machine. This would be at the rate of 8,640 tons for twelve machines working twelve hours, and I was informed that 7,000 tons were generally unloaded in eleven to twelve hours. A vessel would be filled in about four hours, but the work had been performed in two hours.

The ore as taken from the steamer either can be dumped on the stock piles or can be shot at once into the railway wagons for transport to a distance. The Carnegie Steel Company have their own port on Lake Erie at Conneaut, about 135 miles from their blast furnaces at Pittsburg. In order to complete the chain of control from the mines to the works they have established a railway of their own, exclusively for mineral traffic. This line is admirably equipped with very powerful locomotives, some weighing with tenders as much as 130 tons, and with steel wagons, each carrying

* This series of articles on American Industries was written by an expert of The London Times, who made an extensive trip through this country in order to prepare the articles, the first of the series being published in the SUPPLEMENT of July 21.

45 to 50 tons of ironstone, expressly suited for the traffic. The absence of passenger service much simplifies the working of the line, and the cost of carrying the ore is stated to be from one-sixth to one-seventh of a penny per ton-mile. The trains consist of from 25 to 30 loaded cars. The weight of the steel wagons carrying this large burden of 45 tons is no more than 15 tons; a ratio of tare unapproached, so far as I am aware, in British practice.

It will be seen by those acquainted with the mineral industries of Europe that the methods of handling material adopted in the United States differ essentially from those in vogue on this side of the Atlantic. To a large extent the Americans have been forced by circumstances into new departures and improved methods by geographical considerations and the exigencies of their position. None the less, credit is due to them; and it is credit that no fair-minded Englishman will withhold. The ingenuity they have displayed and the courage they have shown in tackling difficulties during the uphill fight in putting their steel industry on a footing to compete with our own in neutral markets is worthy of all praise and admiration.

THE WEIGHING OF LOCOMOTIVES.

The locomotive in an inoperative condition gives the observer the impression of a great weight without his having any suspicion that such total weight is intelligently distributed over the different axles. The judicious distribution of the load over the different wheels is nevertheless one of the numerous delicate problems that the engineer has to solve, and upon the excellence of the solution depends the equilibrium of the engine in running. The weight to be given the driving wheels, that is to say, those which are actuated by the steam engine properly so-called, is a matter of great importance. If the weight is too light, it involves sliding through want of adherence, and, if it is too heavy, it requires on the part of the cylinders an excess of power. In such cases the work is irregular. It will be seen, then, that it is of the highest importance for a railway company not to put a new locomotive in service until after it has assured itself that the distribution of the weight has been effected conformably to the calculations of the engineers who have designed it.

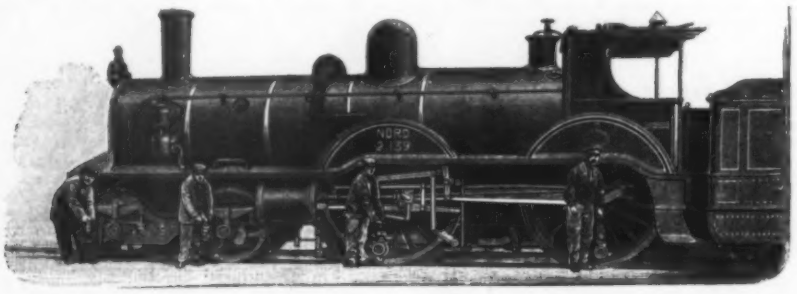


Fig. 1.—WEIGHING A LOCOMOTIVE OF THE RAILWAYS OF THE NORTH.

The great Baldwin works in the United States proceed in the following manner: Scales provided with a special seat (Fig. 1) are mounted upon a small four-wheeled truck of the same gauge as the track upon which the locomotive runs. These scales, thus placed under each pair of wheels, give the load at the point considered, and the regulating of the suspension springs is done in accordance therewith.

In order to render the loads of its locomotives regular, the Compagnie du Nord (France) employs movable scales of the Erhard system (Fig. 1). These scales consist of a system of double levers, and the small arm of one of these levers carries a seat upon which is placed the spring of the wheel to be weighed. On the other hand, the equilibrium is obtained by means of a weight that slides over the long arm of a second lever, which is graduated as in ordinary steelyards. The whole is very strong, and yet easily maneuvered. Fig. 2, which gives the details of the scales, will allow the application, which is of great simplicity, to be understood. For the weighing of its engines, the Compagnie de l'Est employs weighing bridges, upon which the axles are placed. The entire system comprises eight bridges, each capable of carrying 17,600 pounds.

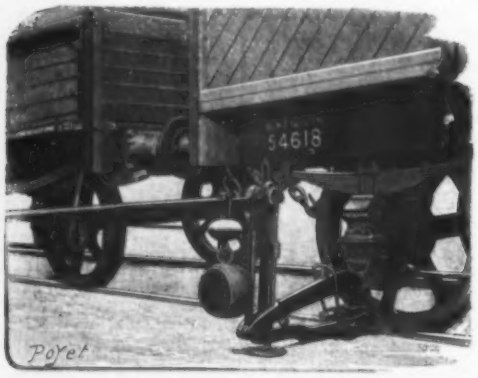


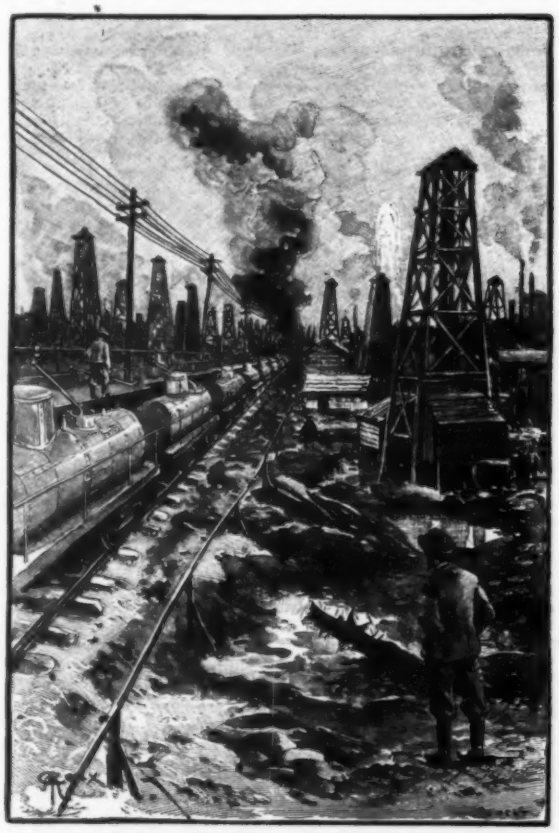
Fig. 2.—DETAILS OF THE SCALES OF THE RAILWAYS OF THE NORTH.

As may be seen, a locomotive is not only a propulsion engine in which all the parts connected with transmission, power and motion are admirably combined; but also an intelligently proportioned mass.

For the above particulars and the illustrations we are indebted to La Nature.

AMERICAN PETROLEUM.

The introduction of rational methods of securing and working petroleum and its universal use date only from about 1860, when the celebrated oil wells of Pennsylvania were discovered by accident. An artesian well was being bored at Titusville, but instead of the hoped-for water, oil was struck at a depth of 72 feet and the well continued to yield over a thousand gallons a day. This well was exhausted in a few months, but the discovery became known and people were soon convinced that a large supply of oil was deposited there. The importance of the discovery was appreciated and great numbers of people rushed to the place hoping to become rich at once with very little trouble, for each one was sure that if he could secure a good well his fortune would be made. In fact, there was a "petroleum fever" similar to the "gold fever" which seized the world after the discovery of gold in California. Boring was begun where there was the slightest indication that oil might be found, and as early as the year 1861, 2,000 derricks had been raised. But here, as elsewhere, Dame Fortune was capricious; some would strike the richest wells after boring only a few yards and others would bore 300 feet or more without finding the much-desired oil. Many spent all they had in such unsuccessful work and went away beggars from the place where they had hoped to gain great riches, and some stole what they wanted, for many adventurers who had nothing to lose and everything to gain had been attracted as well as capitalists. The one desire was to find a great well, and boring was often begun without any thought as to what should be done with the oil in case it was successfully brought to the surface. If there was an abundant yield the oil frequently shot up into the air like a fountain, no means having been provided for catching and transporting it. Naphtha overflowed the whole region and the oil and gases ignited at the first open fire, or, in some cases, were set on fire by evil-doers; then large settlements were soon in flames and the work of many months was destroyed in a few hours, for it was impossible to extinguish these fires. The oil which streamed unhindered into a river carried the flames with it, forming a raging sea of fire that extended for miles.



PETROLEUM WELLS IN PENNSYLVANIA.

Gradually the excitement quieted down and the speculators and men who worked without any preconceived method disappeared, their places being taken by companies with capital, thus changing the character of the whole region, which had been a barren wilderness to be reached only by days of tiresome and even dangerous travel. Roads were laid out, railroads built and proper arrangements made for carrying the oil away either by rail or on specially constructed boats in a canal that was built for this purpose. The ever-practical American mind showed itself in the introduction of greatly improved methods of securing and refining the oil, as well as in transporting it. Shipment by rail and boat proved too expensive and slow, and so pipe lines were laid through which it flowed uninterruptedly from the wells to the refineries, and from there to seaports, where great reservoirs are provided. As it was necessary to carry most of these lines over hills or mountains, pumps were introduced for forcing the oil through the pipes.—Der Stein der Weisen.

FRENCH AERIAL NAVIGATION.

In the huge U-shaped building where most of the articles made in this world can be seen—from mighty machines of shining steel and brass to the most delicate fabrics fashioned by their almost human intelligence—one occasionally comes upon surprising cases, suggestive collections which open unexpected avenues of thought rather alien to the superbly material forcefulness of surrounding exhibits. Such are the remarkable cases of old keys, ancient locks, and ornamental iron work with which several happy hours unconsciously slipped away. One could scarcely imagine that so many beautiful forms of historic keys could exist, until these noteworthy collections of M. le Secq des Tournelles had been studied. Another is a fascinating room full of antique clocks and watches, hour-glasses and clepsydras—the history of time, as it were, and still serviceable in annihilating our common father, though perhaps in a different way from that which their long-vanished makers intended. Of scarcely less interest is the corner in which are brought together all ancient devices in connection with artificial light—candlesticks of exquisite old shapes and many materials, snuffers and trays, numberless shelves of extinguishers, Roman lamps and candelabra, an epitome of historic illumination.

But I discovered to-day a veritable well-spring of pleasantness, after a somewhat arid stroll past wheels and leather, carriages and carpets. My attention was attracted by a large, bat-like object suspended overhead, showing a multiplicity of mysterious and rather chaotic wings: a bird, a butterfly, an August cicala, a bat, and a whirling maple seed combined, might perhaps describe the Ader type of flying-machine "éclaireur et torpilleur." It seemed to suggest the objects below. Captive balloons of many models, with various kinds of cars and baskets, opportunities for choice in ropes and pulleys, and even the pongee silks made in China and Japan for gaseous inflation, attracted few gazers; but the case containing a picture of Andree and his associates, Fraenkel and Strindberg, was constantly surrounded, as the one farther on, representing the frozen fjord and glistening mountains above which their balloon was poised on the 11th of July, 1897. Aeronautical instruments for meteorological observation are grouped together, and a neighboring map shows the tracks of various high-air voyages from Paris to a distance of 1,200 kilometers. All these, with flying machines of different principles and epochs, "grapplers" and anchors for landing (unexpectedly or otherwise) upon earth and sea, make a very modern section, of which the interest is not diminished by a glance at the fine photographs taken from different altitudes. These appear to be a series of particularly good enlargements. St.-Genis Laval (Rhone) from a height of 650 meters is clear and perfect, while a charming picture of cumulus cloud in process of formation, allowing between its masses distant but distinct glimpses of fields and woods, was taken from a height of 1,350 meters. The Pont-des-Vaux (Ain) from 1,600 meters is small yet still clearly defined, and lovely cloud photographs are shown, made at 2,050 meters altitude.

It will be remembered that scientific ascents for the purpose of getting above the accidents of meteorologi-

cal circumstance have not been unknown; and here may be seen the actual substance of Le Volta, in which the famous astronomer Janssen made his upper-air pilgrimage on the 2d of December, 1870. This devoted observer, thus leaving besieged Paris in ample time for the sun's eclipse of the 22d, was not rewarded for his energetic faithfulness; an overcast sky being his portion upon the important day. The siege of Paris, indeed, is constantly memorialized in these aerial cases, in ways other than scientific. One of them contains a fragment of the material used by Eugène Godard in constructing Le Washington for use during that memorable winter; some of the dispatches thus sent overhead; and pictures of the balloon high above the city, casting its shadow upon surrounding clouds. Here, too, one sees the carefully stuffed body of the carrier pigeon celebrated at that troublous time—another sort of aerial communication, to be sure, but perhaps appropriately commemorated here. The tragic death in the sea of Prince on the 30th of November, 1870, and of Lacaze, who ascended in the Richard Wallace the 27th of January, 1871, and also perished in the ocean, are represented several times in harrowing pictures. Other cases contain volumes upon high-air navigation, volumes of L'Aéronaute, and numbers of The Journal des Voyage, illustrating this phase of human endeavor. Also exhibited are the kite explorations of upper air brought to such successful issue by Mr. A. Lawrence Rotch of Blue Hill. The familiar face of Dr. Abel Hureau de Villeneuve and those of MM. Henry Gifford and Maurice Mallet look from one frame, beside many old engravings of ascensions, successful descents, and fatal endings.

But historical collections of balloon memorabilia may be both poetic and æsthetic. This is proved by the quaint and beautiful articles owned by M. Louis Bérean and M. Albert Tissandier shown near by. Curious old prints published more than a hundred years ago, some of them colored, represent every sort of attempt at aerial navigation, sometimes seriously, often in amusing caricature, with catastrophes, both humorous and ghastly, which would appear to have been particularly dear to the hearts of artists and engravers in 1783 and thereabouts. Stone and marble tablets, one of that year in memory of De Rozier, oddly decorated medals in silver and bronze, an ancient oil painting of a captive balloon reluctantly restrained by ropes held in the tugging hands of a dozen blue-coated gentlemen of a past century, fill the first case, with a superb lot of old books. Among them is "Essai sur la Nautique Aérienne," published by Eugène Onfroy in 1784, and a fine old volume issued in Brescia in 1670, dedicated "Alla sacra Maestà Cesarea del Imperatore Leopoldo I." and volume iii. of "La Découverte Australe, par un Homme-Volant; ou Le Dédale Français; Nouvelle très-philosophique," of which the first volume is in another collection farther on. Volume i., however, has a more amusing frontispiece, wherein an airily attired individual in wings and an umbrella, carrying a suspended basket below his feet, is about to set sail into space from the summit cliff of a high mountain.

The painstaking and beautiful accumulation of M. Tissandier shows silver and pewter plates engraved with balloon subjects, numberless handsome snuff-boxes of multitudinous designs of the same idea painted or inlaid, old prints in quaint frames; cups and saucers, sugar bowls, water pitchers of all epochs; a vase in shape like a Japanese saké-bottle, a tiny drum of ancient form, silver candlesticks, miniatures, and jewelry set in brilliants, a cane, a sword, silver-handled knives, nearly thirty plates, and more than two dozen exquisitely painted fans, long gloves, brass escutcheons and ivory carvings—all old, all exhibiting in one form or another the thought of balloon voyaging or navigating the air in some manner. It forms a noteworthy and most curious aggregation, even a lot of antique printed cottons adding their pictorial testimony to aerial history.

For the sun's eclipse of August, 1887, Prof. Mendeléef is "docteur ès sciences," and at the head of a force of computers in the Paris Observatory, charged with the very important duty of preparing a catalogue of the stars from the plates of the International Astrographic Congress. For the solar eclipse of the present year, May 28, she made another balloon ascension, but was unable to reach an altitude entirely above the mists and cloud enshrouding Paris at that time. The disappointment was less vital since the eclipse was not total here. Mlle. Klumpke has read a brilliant paper this week, at the International Congress of Women, upon feminine achievements in astronomy—a subject upon which she is undoubted authority.

Of course, there is a captive balloon in the Exposition grounds, for the amusement of the laymen; but of far greater interest is the exhibition of free balloons at Vincennes. Last Sunday eight fully inflated air-voyagers of forty or fifty feet in diameter were simultaneously shown. Four ascended in twenty minutes, with their aeronauts. In one a lady started on the unknown voyage with two aeronauts; in another, the captain of the celestial craft started alone. The lower air was perfectly quiet when the balloons were freed, and all took different directions, according to the speed of their vertical ascent and the corresponding air currents which they struck later. They set forth at four o'clock, but at sundown only one had entirely disappeared from the gaze of the vast throngs watching at Vincennes. The experiments are conducted under the auspices of the Committee on Aerostation, of which the veteran expert De Fonvielle is secretary.

The subject of human transportation through space will always be of profound interest until it is a practically and comfortably established fact of every-day occurrence. And France is surely the country in which this problem is liable to meet its final solution. —Mabel Loomis Todd, in The Nation.

A fifth submarine cable between England and Germany is projected.

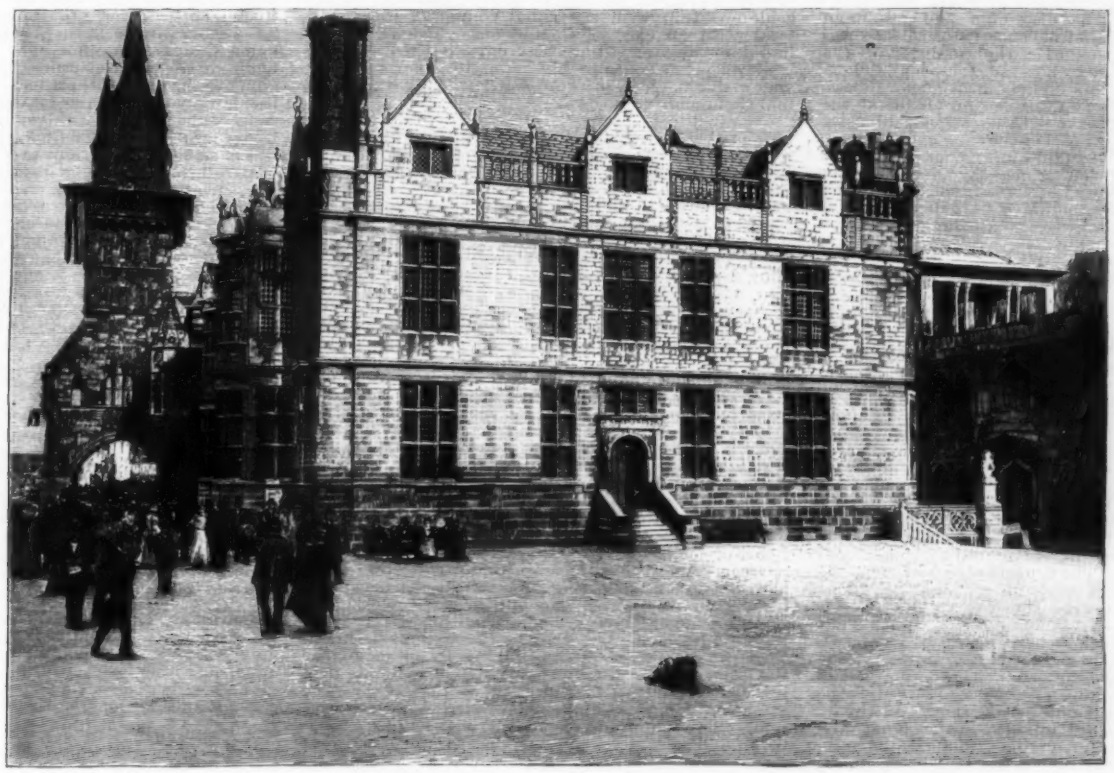
THE PAVILION OF GREAT BRITAIN AT THE PARIS EXPOSITION.

GREAT BRITAIN naturally stands in the front rank of the foreign powers that exhibit in the greatest number of groups. Its official palace on the Rue des Nations is a manifestation of its own genius, which has completely transformed the site allotted to it upon Quai d'Orsay.

How could foundations established by Frenchmen have supported an English palace, and especially a palace of metallic framework of English iron brought from London and put together by English workmen? It must be recognized, moreover, that the architect of the structure has employed this superb material with perfect taste. The platform is of iron, and so are the stairways, and the whole presents a solid and definitive aspect.

The pavilion is on the plan of a typical English country house. The north side is copied from Kingston House, Bradford-on-Avon, which was built in the 17th century; while the south side is a copy of another house of the same period. The east and west sides, as well as the internal arrangements, were especially designed for the Exposition. The building is of red brick with large mullioned windows. It has been furnished and decorated by the principal firms of London.

The Prince of Wales has installed in this structure his superb collections and the marvels of art that were distributed through his different residences. On certain days he will hold receptions here, but at other times all the halls are open to visitors.



THE PAVILION OF GREAT BRITAIN AT THE PARIS EXPOSITION.

MANUFACTURE OF CARAMEL.

THE following abstract of a paper by Mr. A. Gordon Salamon and Mr. E. N. Goldie, read at a recent meeting of the London section of the Society of Chemical Industry, is quoted from The Brewers' Journal:

The object of the investigation was to clear up certain questions connected with the manufacture of caramel from glucose. The two essential selling features of caramel are maximum color intensity in ratio to density, and non-deposition in the liquids it is intended to color. All stages of the change in the conversion of glucose into caramel were carefully studied in the factory by the authors, and it was found that the temperature from the time at which the glucose melts to the formation of color was materially lower than when cane sugar was employed as the starting material. The finished product from each source was shown to be substantially the same with respect to its behavior toward reagents, and it was urged that for technical purposes, at all events, the two might be regarded as identical.

An exhaustive sketch was given of the chemistry of caramel, the works of Gelis, Peligot, Pohl, and others being discussed. The scanty technical literature was also dealt with, and in this connection certain processes were described which had been introduced into England from the Continent, where some years ago they had been worked secretly. These consisted exclusively in the use of ammonium carbonate, potash, and soda. The analytical data requisite in order to judge the merits of a caramel were fully discussed, and in the opinion of the authors these consisted in the determination of the color intensity in terms of a given standard, the density, the mineral matter, the cupric oxide reducing power, and the behavior toward proof spirit. The action of citric and tartaric acids on a solution of caramel was stated to be a valuable test. A good caramel should, of course, be unfermentable, and the authors showed that this might be controlled analytically by fixing a definite maximum limit of cupric oxide reducing power.

Ordinary commercial samples of caramel were treated with absolute alcohol, whereby they were separated into a soluble and insoluble portion. These portions were isolated, dissolved in water, and the color inten-

sity for a solution of definite gravity, as well as the cupric oxide reducing power determined in each case, with the result that the portion soluble in absolute alcohol was found to have very little color intensity indeed, but much the same cupric oxide reducing power as that insoluble in absolute alcohol, to which the color intensity of the sample is practically due. It is interesting to note that the ratio of substance soluble to substance insoluble in absolute alcohol in a well-made caramel is found to be on an average 15 : 85. The desideratum of the caramel manufacture is therefore to obtain a caramel of maximum color intensity, the coloring principles of which are permanently soluble to as high a degree as possible in alcohol of a strength between the limits of proof spirit on the one hand and absolute alcohol on the other. Glucose heated per se will not produce an intense caramel, but the presence of ammonium carbonate and potash or soda are essential. The authors devoted much attention to the elucidation of an important point from a manufacturing point of view, namely, what substances other than those just mentioned could be used in making caramel from glucose so that the results might be the same or better. They found that a great improvement was effected both as regards color intensity and non-precipitability in proof spirit by employing in the manufacture two parts of ammonium carbonate, and one part of ammonium chloride. Among the many substances tried were the ordinary mineral acids and the better known organic acids. Acetic acid was found to give uncertain results as regards color intensity; in many instances, however, this was high, and, generally speaking, the flavor was pleasant. Tartaric and citric acid gave intensity of color, but this was accompanied by harsh flavor. Potassium and sodium salts gave unsatisfactory results, in that, as a rule, a precipitate occurred in beer colored with the caramel made by their use. Of the various ammonium salts tried, ammonium tartrate gave the best results, ammonium acetate gave results which could be described as good, while ammonium sulphate gave fair color intensity, but decidedly harsh flavor. The maximum and minimum quantities to be employed of some 20 or 30 salts was determined, and in each case the qualities of the various products obtained were ascertained by the determination of the factors already mentioned. It was shown that by the addition of caustic alkalis at the final stage in the production of caramel, color intensity could be increased, and the tendency to deposit from a solution annulled. The quality and general character of the caramel was proved to depend enormously on the amount of glucose used. It was found that a well-made maize-glucose, containing a high percentage of dextrose, might by appropriate treatment be made to yield caramel of the best quality.

PRODUCTION OF IPECACUANHA.

ONE of the most widely used of all vegetable drugs is the powerful emetic ipecacuanha, which is obtained from a Brazilian shrub. The French Conseiller de Commerce, at Cuyaba, in the State of Matto Grosso, Brazil, gives in a recent report an interesting account of this plant, which has in that State and the neighboring districts its only habitat. The drug is obtained from plants which attain a height of from 12 to 16 inches. The leaves are oval, dark green, and sharply ribbed, and the white flowers give place to an ovoid fruit containing black seeds. Besides the Ipecacuanha Cephoelis, or the "white ipecacuanha," as it is generally known, there are several other varieties which are somewhat different, but all are used for the same purpose, and are distinguished as brown, black, and striated ipecacuanha. The drug is obtained from the root of the plant, where it occurs in quantities about the size of a quill, between the layers. The taste is acrid and bitter, and the odor is nauseating. That found next to the bark is most active in its effects, having in the highest degree the emetic property, due to the active principle known as "Emetine." The State of Matto Grosso which, as before observed, is the habitat of the plant, is one of the richest in Brazil, among its many natural products being gold and diamonds, rubber, sarsaparilla, jalap, jaborandi, copaiba, various gums and drugs of several kinds. Ipecacuanha is found in the north and northwest of the San Luiz-de-Caceres, formerly in the Villa Maria region, and its habitat covers an immense area comprised between a network of rivers in Brazil, Bolivia, and Paraguay. The dense foliage of the forest of this region provide the dank and humid conditions which favor the growth of the shrub. The Brazilian product is known as Rio Ipecacuanha, and the product secured from similar shrubs in other countries passes under the name of the port from which it is shipped. Attempts have been made to transplant the shrub and to cultivate it in British colonies in various parts of the world, but without success, and Brazil continues to be the only source of supply for the best grade. The process of gathering the plant is perfectly simple, and during the rainy season, while the ground is soft, is very easy. A stick is inserted under the root, and while this is raised with one hand the entire plant is pulled out with the other. As little care is given to the protection of enough plants to secure a future supply, the output is growing smaller, and the price consequently higher each year. The scarcity of workmen is a great difficulty. In the dry season the roots cannot be gathered, and it is at this season when any one adapted to the work is engaged in gathering rubber. During the rainy season, from October to April, when the plants may be easily drawn from the ground, women are usually employed for the work.

Lord Rayleigh has determined the weight of hydrogen gas dried by means of liquid air acting as a cooling agent. In recent experiments by himself and others, phosphoric anhydride has been the desiccating agent, but a doubt remained as to whether on the one hand the removal of aqueous vapor was complete, and on the other whether some new impurity might not have been introduced. The object was not so much to make a new determination of the highest possible accuracy as to test whether any serious error could be involved in the use of phosphoric anhydride, such as might explain the departure of the ratio of the densities of oxygen and hydrogen from 16 : 1. The experiments proved that no serious error could result in this way.—Proc. Roy. Soc.

TRADE NOTES AND RECEIPTS.

A Thermometer of Quartz.—A thermometer of quartz for high temperatures is described by A. Dufour, in the Chemiker Zeitung. Some consists of a vessel and a tube of molten quartz. It is filled by suction of liquid tin, so that it can be used from 240° to 580° C.

Since quartz does not soften below 1,000° to 1,200° C. it is possible to produce a thermometer up to 900° C. For determining the scale, the boiling points of quicksilver and sulphur are employed; for higher temperatures, those of cadmium and zinc.

Cement for Belts.—Mix 50 grammes of fish glue with equal parts of whey and acetic acid. Then add 50 grammes of garlic in paste form and boil the whole in the water bath. At the same time make a solution of 100 grammes of gelatine in the same quantity of whey, and mix both liquids. To the whole add finally 50 grammes of 90 per cent. alcohol, and after filtration a cement is obtained, which can be readily applied with a brush and possesses extraordinary binding qualities.—Neueste Erfindungen und Erfahrungen.

Analysis of Beeswax.—A. Tunaro lays stress on the fact that only a complete analysis can establish an adulteration of the wax with indication of the kind and degree of same. Beside the ordinary methods, such as the estimation of the specific gravity, melting point acid number, iodine number, etc., Tunaro attaches value to the methods of Fehling and Donath. According to Fehling the wax is boiled about one minute with alcohol (92 per cent.) and then cooled off. After filtration no turbidity must result with aqueous calcium chloride solution. Cloudiness points to the presence of stearic acid. Upon heating of 10 grammes of wax with 120 grammes of water, and 1 gramme of sodium carbonate, the liquid must likewise remain clear after cooling, if the wax is pure.

The process of Donath is as follows: Keep 1 gramme of wax boiling for one minute with 8 grammes of nitric acid, next thin with the equal volume of water, and treat with an excess of ammonia. The poured-off liquid, in the case of pure wax, must be straw-colored (yellow). If it contains an admixture of rosin, it is yellowish-red, red or brown.—Zeitschrift für Nahrungs- und Genussmittel.

Colored Fireworks.—Blue Flame.—I. Ore pigment, 2 parts; charcoal, 3 parts; potassium chloride, 5 parts; sulphur, 13 parts; potassium nitrate, 77 parts. II. Sulphur, 15 parts; potassium sulphate, 15 parts; ammonia cupric sulphate, 15 parts; potassium nitrate, 27 parts; potassium chlorate, 28 parts.

White Flame.—I. Potassium nitrate, 30 parts; sulphur, 10 parts; antimony sulphide (black), 5 parts; flour, 3 parts; powdered camphor, 2 parts. II. Charcoal, 1 part; sulphur, 11 parts; potassium sulphide, 38 parts. III. Stearine, 1 part; barium carbonate, 1 part; milk-sugar, 4 parts; potassium nitrate, 4 parts; potassium chlorate, 12 parts (Merck's Report). As a general rule, a corresponding quantity of shellac may be taken instead of the sulphur for inside fireworks.

Smokeless Vari-colored Fire.—First take (this is essential) barytes or strontium, bring to a glowing heat in a suitable dish, remove from the fire, and now add the shellac. The latter (unpowdered) will melt at once, and can then be intimately mixed with the barytes or strontium by means of a spatular. After cooling, pulverize. One may also add about 2½ per cent. of powdered magnesium to increase the effect. Take, for instance, 4 parts of barytes or strontium and 1 part of shellac.

Green.—Melt shellac 5 parts; barium nitrate, 1 to 1·2 parts; pound after cooling and add 2 to 5 per cent. of barium chlorate. The latter enhances the coloring.

Red.—Shellac, 5 parts; strontium nitrate, 1 to 1·2 parts. Preparation as above. In damp weather add 1 to 4 per cent. of potassium chlorate to the red flame; the latter causes a little more smoke. The flames give little smoke, and can be burnt in the room. The smoke is not molesting. They burn well and very light. The composition should be shaped into a long-ish hill.—Neueste Erfindungen und Erfahrungen.

Production of Pure Calcium.—Pure calcium is produced after the following process:

Anhydrous calcium iodide is heated with sodium, with exclusion of air to dark redness. The calcium formed dissolves in the sodium and crystallizes out after the cooling.

After extracting the molten mass with absolute alcohol, it remains behind in hexagonal tablets or rhombohedrons. It is preserved in tubes closed up by fusing. In the vacuum at one millimeter pressure it melts into a white silvery liquid.

Pure calcium combines with hydrogen at red heat into white calcium hydride; same is an exceedingly energetic reducing agent. When brought in contact with water, similar to calcium carbide, powerful decomposition sets in.

It also combines with nitrogen to calcium nitride Ca_3N_2.

Carbon to calcium carbide.

Fluorine at ordinary temperature—the mass turns white-hot.

With nitrogen dioxide it ignites.

Anhydrous phosphoric acid is reduced underneath red-heat with glowing and explosion.

Anhydrous boracic acid } are reduced.
Silicium dioxide ..... }

With liquid ammonia it combines at —40° C. into calcium-ammonium. If same is decomposed in the vacuum, the calcium is obtained in such a fine state that it ignites in the air.

With water calcic hydrate is formed.

With hydrogen sulphide calcium sulphide results.

Heated in the hydric chloride current calcium generates calcium chloride.

Fuming nitric acid dissolves calcium slowly; a slight addition of water accelerates the solution.

Fuming sulphuric acid dissolves calcium with separation of sulphur and generation of sulphuric dioxide.

Hydric sulphide results, if monohydrated sulphuric acid is employed for the solution.

Calcium unites with all simple bodies, argon excepted, and is one of the most reactive elements.—Zeitschrift für angewandte Chemie.

SELECTED FORMULÆ.

Insect Powders.—Naturally, the great difficulty that has to be met in the insecticide manufacture is to find things poisonous to insects and incapable of doing harm to the objects, living or dead, which are to be protected. The insects far exceed all the rest of the animal world put together in number of species, and are more numerous as individuals than the combined forces of all the other living things which thrive upon the land. They have gained this pre-eminence by superior physique and stamina, and what hurts them generally hurts a plant or a dog or a human being a great deal more. On the whole, there is no insecticide so effectual as mechanical pressure, but the great drawback of that is that it can account only for one, or for two or three, at the most at a time, and to encounter the hosts of a class Insecta something that acts less by retail and more by wholesale is a desideratum. Hence there are, and will be, various insecticides upon the market, of which we purpose giving a short description. To begin with, here is a list of the most important substances used as insecticides, alone, or in combination of two or more of them. One or two of these substances have to be used with extreme care and discretion.

Pyrethrum	Camphor
Whale oil } in the form	Cayenne pepper
Fish oil } of soap,	Tobacco
Soft soap	Snuff
Paraffin	Assafetida
Prussic acid	White hellebore
Paris green	Eucalyptol
White lead	Quassia
Sulphur	Borax
Carbon bisulphide	Acetic ether.
Acorus calamus.	

The chief of the insect powders is that obtained by crushing the dried flowers of the pellitory (Pyrethrum). The leaves, too, are often used. The species of Pyrethrum chiefly used are P. roseum, and P. carneum. They are cultivated in the Caucasus, whence the specific name Caucasicum sometimes used. Pyrethrum belongs to the natural order Compositæ, and is closely allied to the chrysanthemum. The active principle of it is not a volatile oil, as stated by some writers, but a resin, which can be dissolved out from the dry flowers by means of ether. The leaves also contain this rosin but in smaller proportions than the flowers. Tincture of pyrethrum is made by infusing the dried flowers in five times their weight of rectified spirit of wine. Diluted with water it is used as a lotion. Borax powder makes a very good insectifuge. It appears to be particularly effectual against the common or kitchen cockroach. Camphor is also used, and the powdered dried root of Acorus calamus, the sweet flag. A mixture of white lead with four times its weight of chalk is also highly recommended. The fish oil soaps used in a powdered form are made from various recipes, of which the following is a typical example:

Take—Powdered resin	2	pounds.
Caustic soda	8	ounces.
Fish or whale oil	4	"

Boil all together in a gallon of water for at least an hour, replacing some of the water if required. Eucalyptol is in good request as a preservative against insects.

A lotion of it is made from the following recipe:

Tincture of pyrethrum	50	parts.
Eau de cologne	40	"
Eucalyptol	10	"
Acetic ether	5	"

For plants, tobacco is of historic usage, in the form of tobacco water, or infusion of the tobacco in the form in which it is smoked, and also as part of various kinds of incense used for fumigating plants and greenhouses. Snuff is also used for these powders. The following are two formulæ for making them:

A.—Snuff	50	pounds.
Powdered white hellebore	5	"
Assafetida	3	"
Cayenne pepper	2	"
Flour	6	"

Enough saltpeter is added to make the stuff smolder when set fire to.

B.—Tobacco	75	pounds.
Sulphur	28	"
Assafetida	5	"
Flour	3	"

Liquids for spraying plants are made with soft soap, paraffin, extract of quassia, or white hellebore, and water. Paris, or emerald green, which contains arsenic and copper, is used as a powder, but is highly dangerous for animals, especially if it gets into the stomach by licking or into the circulation through a scratch or other open wound.

Prussic acid has recently been largely and very successfully employed for freeing trees from insect pests, especially in America. The tree is covered up for the time being in a sort of tent, under which the fumes of the acid are set free, and by which they are confined for a sufficiently long time in contact with the tree. Prussic acid, being the most deadly poison with which we are acquainted, naturally requires careful and responsible handling, but its efficacy against insects is unquestionable, as every entomologist who keeps a cyanide bottle is well aware.—Oils, Colours and Drysalteries.

To Dye Oak Black.—Oak may be dyed black and made to resemble ebony by the following means: Immerse the wood 48 hours in a hot, saturated solution of alum, and then brush it over with a logwood decoction, as follows: One part of the best logwood with ten parts of water, filter through linen, and evaporate at a gentle heat until the volume is reduced one-half. To every quart of this add from 10 drops to 15 drops of a saturated solution of indigo. After applying this dye to the wood, rub the latter with a saturated and filtered solution of virdigris in hot concentrated acetic acid, and repeat the operation until a black of the desired intensity is obtained.—Revue Pract.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

German Stoneware Factory.—Consul Harris sends from Mannheim a description of a German stoneware factory for sewerage and chemical industries at Friedrichsfeld, a small village about six miles from Mannheim on the railroad leading to Heidelberg. He says:

The plant, which has been in existence for many years, was almost wholly rebuilt in 1894 and 1895, and is now one of the largest and best equipped plants of its kind in Europe. Its product, amounting to an average of ten carloads of finished ware per day, is shipped to many parts of Europe and to the United States. The plant covers several acres aside from the ground used for storage. Some of the buildings are three and four stories high; all are built of brick or stone and are of costly construction. Upward of five hundred men are employed in the works. The company employs no women and but few boys. It has its own fire department, a system of insurance among its employees, and an arrangement by which medical attendance is furnished employees in case of sickness.

The product consists of various forms of stoneware used for sewerage purposes. The clay used is brought from the mountains near Heidelberg and other points close by. It is said to be of excellent quality, and is found in great abundance. The kilns and ovens are of the types used in the United States, as also most of the machinery, so far as I could learn. The machines used in grinding the clay are unlike those formerly, and perhaps now, used in the sewer-pipe works in parts of the United States. The clay is here passed through three separate grinding machines of similar construction, consisting essentially of a series of heavy parallel, horizontal rolls having roughened surfaces, so constructed as to feed the clay between them and at the same time crush and grind it. Elevators and carrying devices are used throughout the plant. An electric plant furnishes light where artificial illumination is required. Blowing machines carry off the dust.

The sewer pipe made by the concern differs but little from that generally seen in the United States. The sections are, as a rule, longer than the American product. They are made with a thread-like groove extending five or six times around the pipe and beginning probably three-fourths of an inch from the smaller end of the pipe. This groove is from one-eighth to one-fourth of an inch deep, depending on the size of the pipe. There is a corresponding groove on the inside of the collar at the other end of the pipe. The managers tell me that sewer pipe is generally made in this form in Germany, and that an asphalt filler is used in place of cement. They say that in the laying of pipe there is sure to be more or less settling at the joints; that cement, if used, cracks and does not readhere, and leakage is likely to occur, while asphalt, being more elastic, yields to the settling without cracking. It is to be remembered that in Germany this pipe is much used in connection with domestic and other sanitary plumbing, where iron and lead pipe is used in the United States. Close-fitting joints, therefore, become a matter of special importance here.

To prevent the pipe from settling and getting out of place by lateral movement, a stoneware sill having a broad base and concave surface, with a radius corresponding to that of the pipe, is used. I am advised that these sills are specified in the contracts for much of the street sewerage in this Empire.

A large amount of sewer pipe of elliptical and egg form is used in Germany. This is also manufactured by the Friedrichsfeld Company. This is, of course, laid with the side having the smaller arc of curvature down; in other words, as if the ellipse or the egg were standing on its small end.

Aside from the sewer pipe of the kinds described, the company manufactures a special line of ware of great variety and much more interesting. The trade in the United States will, perhaps, recall the company's exhibit at Chicago, in 1893. This line includes tubs, vats, piping, accumulators, retorts, pumps, filters, faucets, distilling outfits, and other apparatus used in the manufacture and handling of acids and other chemicals, and in the construction of large galvanic batteries. As is well known, the manufacture of chemicals in Germany is a large industry and gives rise to a demand for apparatus of peculiar construction. No attempt will be made to describe this ware in detail. Much of it is for use in patented or in secret processes, in which technical knowledge would be required for accurate description. Some consist of large receptacles, in form much like the copper kettles frequently used by farmers in the United States for boiling cider. These vessels vary in capacity from a few quarts up to 1,500 liters, or nearly 400 gallons; some are plain, without openings or attachments of any kind; some have openings with stoneware stopcocks; others have filtering devices connected with them. The walls of these vessels are quite thin, as compared with the larger sizes of sewer pipe. Many resemble huge dishes and cooking utensils, the sides and bottoms presenting a smooth, glossy surface with a rich brown color and emitting the clear metallic ring characteristic of perfect ware.

Some of the special forms are quite intricate, and it would seem a matter of much difficulty to make and burn them without a large percentage of loss. Just how great this percentage is I did not learn. Acid pumps are made and equipped with small electric motors, in which cylinders, pistons and valves, all of stoneware, are handsomely burned. I was shown an apparatus for distilling some chemical product. The apparatus is, in fact, an ordinary still, in which the "worm" is one continuous stoneware pipe, perhaps 2½ inches in diameter, and coiled in the usual way on a diameter of some 2½ feet. The pipe in this apparatus is 1900 meters, or more than 60 feet in length. The apparatus stands, perhaps, 5 feet high. The casing by which the coils of pipe, one above the other, are kept in place is of stoneware; the whole apparatus being, in fact, made and burned as one piece and apparently without check or flaw in the making or burning.

Near the last described apparatus was a still larger one, known as a reaction tower, used for the absorption of gases by liquids, as, for example, in the manufacture of nitric acid.

In some of the apparatus shown at the factory, vertical pipes are arranged somewhat like the tubes in a vertical boiler, or in steam radiators for heating purposes. Of course, many of these forms are made largely by hand and require much skill and patience and the greatest care in handling before they are burned. One large receptacle, nearly or quite 8 feet high, probably 4 feet in diameter at the largest part, will hold 5,500 liters, or more than 1,450 gallons. This huge piece of ware is of a rich brown color, and is certainly a handsome product of the potter's art. It bears an imprint of the company's name, burned in one side, and will form part of their exhibit at Paris.

The tubs, troughs, trays, and other ware designed for use in electroplating and other arts requiring large galvanic batteries are made in many sizes and forms, the largest holding nearly 200 gallons. These receptacles, although comparatively light in weight, do not show indication of being warped or twisted in burning. Either the clay used or the method employed in manufacturing and burning this ware, or both, give it a peculiarly well-glazed surface, free from roughness or flaws.

Manual Training in Germany.—There exist at present in Germany, distributed in 605 places, 861 schools and institutes wherein manual training is carried on in 1,514 workshops. Of this number, 836 schools and institutes conduct the training on a pedagogical basis. Prussia has 570 manual-training schools. The 1,514 pupils' workshops comprise 286 independent manual-training schools and 238 public schools, of which 16 are auxiliary schools, where the work is obligatory, 17 are middle-class schools, 41 are high schools (made up of 8 gymnasiums, 6 technical gymnasiums, 12 technical and technical high schools, and 15 boarding schools), 7 are preparatory institutes, 26 are teachers' seminaries, and 93 are boys' asylums; while the remainder consists of various kinds of private educational establishments.

Five hundred and thirty-five workshops are devoted to wood carving, 527 to working in cardboard, and 356 to the carpenter's bench. Of these 68 are closely connected with wood carving, 77 with preparatory roughing-out work, 35 with metal work, 28 with country timbering, 11 with wood and metal turning, and 11 with modeling in clay.

Over 2,200 German teachers have been taught to become instructors in manual training. Of these, 954 were taught in Leipzig and 1,250 acquired training in 33 places in other parts of Germany.—Richard Guenther, Consul-General at Frankfort.

German Iron Works at Bruckhausen.—The Deutscher Kaiser Company, at Bruckhausen-on-the-Rhine, has iron works of magnitude. The ground area is about 1,500 acres. The proprietors were originally a coal mining company, holding about 25 square miles of coal fields, the output of which is placed at 3,300 tons daily. The first portion of the iron plant, constructed in 1890, was the Siemens' steel works, containing seven basic-lined furnaces. Blast furnaces and basic Bessemer converters were added in 1895. The completed plan includes six blast furnaces, 82 feet high. Two compound twin-blowing engines with 6½-foot cylinders and 5-foot stroke are provided for each furnace, whose daily output is from 250 to 300 tons of basic metal. The coking plant includes 256 ovens, of which 188 are at work. The total output will be about 30,000 tons of coke monthly, with 1,200 tons of tar, 400 tons of sulphate of ammonia, and 300 tons of benzole as by-products. The Bessemer plant includes four 15-ton basic converters, with a present output of 20,000 tons of ingots monthly, and also a cogging mill in direct communication with the rolling mills, arranged for the conversion of ingots into rails, billets, or medium-sized joists at a single heat. There are six rolling mills, with a total capacity of 30,000 tons of finished iron and steel per month. The accessory machinery is for the most part served by electric motors, the generators being supplied with steam from boilers fired with blast-furnace gas. Nothing has been spared in the way of equipment to make these iron works the most productive in the Rhenish Westphalian district.—Richard Guenther, Consul-General at Frankfort

Foreign Trade Marks in Brazil.—Minister Bryan writes from Petropolis, June 11, 1900, that he has protested against the Brazilian law enacted last November, forbidding the importation of manufactures that carry labels, prescriptions, or trade marks in Portuguese or partly in that language, which law would cause serious loss to importers of United States proprietary medicines. The 1st of July was named as the date for putting the law into effect, but Mr. Bryan has obtained a postponement until October 1, and hopes that Congress will repeal the law. Mr. Bryan argues that labels are a part of trade marks, and that consequently the law is in violation of the convention of 1878 between the United States and Brazil. He advises all American importers to conform to the requirements of that agreement, by registering their marks in Brazil.

Growth of the Ice Habit in England.—The ice habit is making rapid progress in Great Britain, due largely to the incessant clamor for ice in hotels and public places by the thousands of traveling Americans. Not very long ago, the attendants of public places in England, where nearly everything except ice was provided, would be insulting if one complained because ice could not be had. To-day, all first-class places have a few small lumps swimming in a glass dish, and you pick these out with sugar tongs; and in country inns and even in second-class public houses, they apologize for not having it.

Though very few saloons and restaurants have refrigerators, many private residences now own them; and there would be far more general use of ice if companies were organized to distribute it from house to house. As it is, one must secure it almost by favor from the fishmonger.

Last summer was an unusually hot one, and all the American refrigerators in stock in England by consignment or otherwise were sold. Properly handled, there is good oportunity in England for American refrigerator manufacturers.

Cold storage is a growing business here, and large brewers are putting in extensive cold storage machinery plants; but American manufacturers in this line are not, to my knowledge, in evidence.

Yesterday's issue of The London Daily Mail had an article on ice. In this, the yearly consumption of ice in England was estimated at 450,000 tons (long) and in London at 160,000 tons, and the paper added: "The demand is rapidly increasing, now that the public have awakened to an intelligent appreciation of the cheapness and usefulness of the commodity." One London ice company is credited with having a permanent storage of 10,000 tons to meet unusual hot-weather demands, daily supplies being taken direct from ships which bring it from the mountain lakes of Norway; and, of course, a good deal of ice is manufactured.—Marshal Halstead, U. S. Consul at Birmingham.

Mines and Agricultural Implements in Asia Minor.—During a recent visit to the agency at Mersine and the towns of Tarsus and Adana, lying in the plain of ancient Cilicia, says Consul W. R. Davis of Alexandretta, I was much impressed with the lack of proper methods in farming. This plain is solely an agricultural region, and the work is done mostly as it was hundreds of years ago; plowing is effected with a sharp stick pointed with a bit of iron, harvesting with a sickle, and threshing by tramping out the grain with oxen or horses drawing a sort of sledge.

It occurs to me that with a proper system of farming on this plain of nearly 2,000 square miles, and with modern implements, more than double the usual amount of grain could be raised.

In the hope that business men may take advantage of the present seemingly favorable opportunity in the way of opening mines and introducing agricultural machinery here, Mr. Viterbo, United States consular agent at Mersine, has kindly furnished the following information:

There could be, I think, a good prospect for direct relations between this coast and United States ports if some of our capitalists would take an interest in developing the mining business of this district. Many veins of various ores—chrome, lead, copper, etc.—have been lately discovered, but for want of capital no work has been done.

Some of the natives are working a few veins of chrome and manganese, as the Turkish law permits the prospector to export 2,000 tons of those two kinds of ores before his concession becomes definite. It might be interesting to state here that through this agency there has already been delivered a certified invoice for a shipment of 100 tons of chrome ores of 50 per cent. of oxide of chromium. I have no doubt that the imports into the United States of chrome and manganese ores would be profitable and that a regular trade could very soon be established, if some encouragement would come from the buyers in the United States.

I would call the attention of manufacturers of agricultural implements to the opening here for harvesters, rakes, threshers, etc., which are largely used in this district, although the general methods of cultivation are very defective and obsolete. I think that a light, cheap plow which could be easily drawn by a pair of oxen would find a ready sale here. But I am sure that the most important business could be done in light threshers for grain, especially built for the needs of this country. The steam power thresher ought not to be of more than 1½ to 2 horse power, easily transportable, on wheels by one or two horses, with engine and boiler attached, the fire-box being especially designed to burn straw. The straw coming out of the thrasher ought to be cut in pieces by the machine itself, so as to be in good condition for food. Threshers of this kind, horse or steam power, could be sold by hundreds each year to the small farmers in this part of the country.

German Shoe Experts at Paris.—Consul Warner, of Leipzig, under date of June 8, 1900, informs the Department that at a recent meeting of the Weissenfels Guild of Shoemakers and Leather Workers, an expert was selected to visit the Paris Exposition. The Prussian Government has appropriated 300 marks ($75) toward the project. The shoe industry at Weissenfels, adds Mr. Warner, is growing very rapidly. It has now about sixty shoe factories, which employ over 2,000 workmen. Last year the value of the shoes manufactured amounted to 10,500,000 marks ($2,499,000). It was undoubtedly for this reason that the German Shoemakers' Guild requested the Weissenfels branch of the organization to send an expert factory shoemaker to the Exposition. An expert hand shoemaker will be sent to Paris by the Berlin Shoemakers' Guild, and the Leather Workers' Guild of Mühlheim will send a tanner.

Agricultural Machines in Bulgaria.—Consul Hughes, of Coburg, under date of June 22, 1900, writes:

It is reported that the crops in Bulgaria promise to be exceptionally favorable. Bulgaria can, if effective work is done, become a very good market for American agricultural machines, as the peasants are beginning to appreciate more and more the advantages to be derived from the use of modern machinery.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

No. 793. July 30.—French Market for Lumber—Greek Market for Lumber—American Lumber in Germany—Australian vs. American Meat in South Africa—Government Loan in British India—*New German-American Cable.

No. 794. July 31.—Mining in Alaska and the Klondike—Mining and Metallurgical Production of Germany—*The Steel Production of the World—Manual Training in Germany—German Iron Works at Bruckhausen—Agricultural Fair at Coburg—German Prizes for Lamps.

No. 795. August 1.—*Mines and Agricultural Implements in Asia Minor—*Poultry Raising in Belgium—*New French Spinning Machine—American Passports in Hungary—*Waterworks at Moscow—*German Shoe Experts at Paris.

No. 796. August 2.—Electric Underground Railway in London—*American Shoes in Great Britain—Manchester Exports to the United States.

No. 797. August 3.—Trade in South Africa.

No. 798. August 4.—Notable Economic Conditions in France—Russian Business Methods—Penny Savings Bank in Falkland Islands—Price of Hay in Southwest France—*Foreign Trade-Marks in Brazil—Certificate of Origin in Turkey.

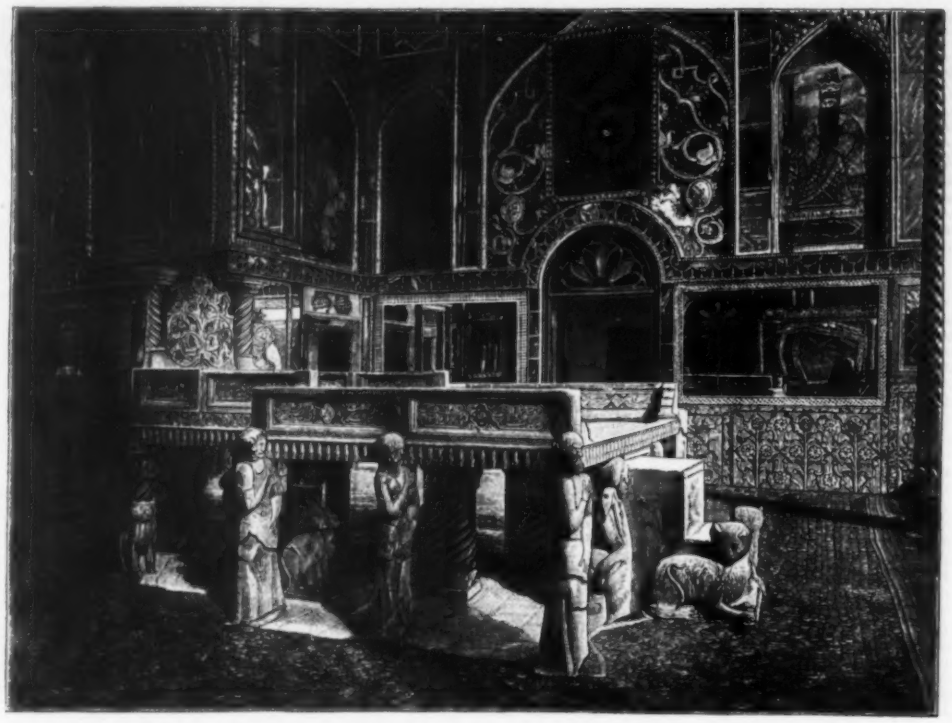
The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

PERSIA AND ITS CAPITAL CITY.

THE European visit of Shah Muzaffer-Eddin has once again drawn attention to the land of Iran. The economical conditions of the country have as a general rule been so exceedingly poor that in the eyes of most merchants and export firms Persia has been of no great commercial importance. Only a few dealers in rare silks and finely woven carpets found it worth their while to trade with Persia. The country is not without natural resources; and within recent years geological exploring expeditions have ascertained that the mineral resources are well worth developing. But the exceedingly lax government and unstable financial affairs could not induce foreign or even native capitalists to invest their money in Persian industries. Persia has many wealthy men, and that their merchants are shrewd in their business dealings is proven by the many Iranian tradesmen who have settled in Russian cities in the Caucasus and on the coast of the Caspian Sea.

Russia, ever watchful for an opportunity to extend her interests, has long desired to develop Persian resources. But the indolence and the indifference of the Persian to everything which might improve his welfare, were not very encouraging. Fortunately, the late Shah Nassr-Eddin was only too willing to better the condition of the country, and the people have ever been friendly to the Czar since Russia crushed out the robber Turkomans, who frequently plundered Persian villages. Russia was, therefore, enabled to proceed in her work with little opposition.

The first task to be performed was the building of roads for commercial communication between the two countries, and particularly the improvement of the highway between the Caspian Sea and Teheran. This latter highway, although of incalculable service to both Russian and Persian merchants, was far from being what it should be. From time immemorial this route from Teheran to the Caspian Sea has been of immense importance. Shah Nassr-Eddin followed it on his visit to Europe; so did his second son, two years ago. Russia immediately began to extend the road for the mutual profit of both countries, and has now finished her first task. The next step will be the construction of a railroad between Kars, in the southwestern Caucasus, and Teheran—the first Persian railway.



THE AUDIENCE ROOM AND THE MARBLE THRONE OF THE SHAH'S PALACE AT TEHERAN.

BEGGARS WITH TAME TIGER.

A PERSIAN NOBLEWOMAN.

Thanks to the efforts of the late Shah Nassr-Eddin, Teheran has become largely European in character. It has many splendid buildings, the most important of which naturally belong to the court.

The military affairs of Persia also improved after Shah Nassr-Eddin had studied the military systems of European countries. He engaged many German, Russian and Austrian officers to bring something like order into the chaotic army of his country.

In Teheran are many typical Oriental schools, among which the "Dar-el-fenum" is the most important. In this institution the pupils study foreign languages, natural science and medicine, under the direction of European teachers. Music is an art which stands in high favor in Persia. In Teheran there are many very excellent orchestras and bands, most of which are conducted by European leaders. In the matter of clothes the rich Persian goes to the very extreme of luxury; but, extravagantly as he may be dressed, he always wears the lamb-skin cap upon his shorn head.

As in most Mohammedan countries, there is no social life, owing to the low position occupied by women. A Persian girl, as soon as she is old enough, is sold by her father, and thereafter becomes virtually the property of a man who may be an utter stranger to her. Custom forbids all social intercourse of women.

One of Teheran's attractions is its so-called class of Luti, who may be looked upon as the counterpart of the Neapolitan lazzaroni; for their chief purpose in life seems to be to do absolutely nothing. In order more successfully to ply their beggar's trade, they often lead with them tame lions, tigers or bears. Their appeals to the sympathy of the rich are generally made not in vain. The illustrations which we present of these beggars, as well as those of Persian life and manners, are reproduced from Ueber Land und Meer.

EXTERIOR OF THE DINING HALL OF THE SHAH'S PALACE IN TEHERAN.

B. T. P. Barker gives an account of a fragrant "Mycoderma" yeast, which is a variety of the Saccharomyces anomalus, Hansen. While experimenting on the fermentation of ginger, he noticed a gray-ish-white floury film of a mould on the surface of sterilized saccharose—Mayer solution (saccharose, 15 grammes, Mayer's solution, 10 c.c.), to which pieces of commercial ginger had been added. The film appeared toward the end of fermentation, a pleasant, fruity odor being apparent; its growth soon prevented access of oxygen, so that the development stopped. The film is made up of a number of small oval and round yeast-like cells, whose optimum temperature of growth is 28° C. The yeast can ferment saccharose (presumably after inverting it), dextrose, lævulose, and beer-wort, but cannot ferment xylose, dextrin, gum acacia, mannite, lactose, or soluble starch. Among the products of fermentation, ethyl alcohol, in some cases as much as 5 per cent., was found in fermented solutions of saccharose, dextrose, and lævulose; of the higher alcohols amyl and butyl alcohols were found in small quantities. The fermented liquids had an acid reaction to litmus, from the presence of acetic, butyric, and succinic acids. The strong odor of fruit ethers varies, ethyl acetate or amyl acetate predominating; in beer-wort fermentations the odor is not as strong as in the cases of dextrose, saccharose and lævulose.—Annals of botany.

THE BORCHGREVINK-NEWNES EXPEDITION.

AT an evening meeting of the Royal Geographical Society held recently in the theater of the University of London, Burlington Gardens, Mr. C. E. Borchgrevink read a paper on the "Results of the Sir George Newnes Antarctic Expedition." The chair was taken by the president, Sir Clements R. Markham.

Mr. Borchgrevink, in the course of his paper, said that it was on December 30, 1898, that the Southern Cross first struck the scouts of the Antarctic ice pack in latitude 51° 56′ S. and longitude 153° 53′ E. The ap-

pearance of the first pack took him by surprise, says The London Times, but he regarded it as a promising sign of early Antarctic spring. The vessel entered the ice pack, and on January 14 high, snow-clad land was discovered to the south. This proved to be Balleny Island. A time of great anxiety followed, and it was only on February 17 that Robertson Bay was entered. The low-lying peninsula of Cape Adare was only sighted when they were close to the shore. The anchor was dropped in ten fathoms of water and a salute fired. The cape and its surroundings seemed freer from ice and snow than on the occasion of Mr. Borchgrevink's first visit in 1894. Then the cape had several feet of ice and snow on the top; now it was absolutely bare. Arrangements were at once made for landing the stores, instruments, dogs, and outfit required by the party who were to spend the winter in the Antarctic. Although the bay was at first free from ice, a strong gale from the southeast placed the vessel in great danger. On March 1 the Union Jack presented to the expedition by the Duke of York was formally hoisted on Victoria Land amid loud cheers from those on shore and a salute from the "Southern Cross," which left next day on its return to New Zealand.

LANDING OF THE PARTY.

The members of the expedition who were left, the first men to winter on Antarctic land, were ten in number. Besides Mr. Borchgrevink they were Lieutenant W. Colbeck, R.N.R., magnetic observer; Mr. Nicholas Hanson, zoological taxidermist; Mr. Louis Bernacchi, magnetic observer, astronomer, and photographer; Dr. H. Kloostad, M.A., M.D.; Mr. Hugh Evans, assistant zoologist; Mr. Anton Fougner, factotum; Mr. Colbein Ellefsen, cook; the Finn Savio, and the Finn Must. The first task was to carry up the various stores landed from the ship to the camping place, some 300 yards from the beach. On March 12, accompanied by Mr. Bernacchi, Mr. Borchgrevink ascended Cape Adare to the height of 3,670 feet. They found traces of the penguins as far as 1,000 feet. But on the 14th all the penguins had left and skau gulls began to get scarce. A magnetic observatory was established, and also a meteorological observatory some 300 yards away from the huts. A heavy gale which came on gave the explorers some idea of the climatic conditions which they

A PERSIAN WOMAN IN HOUSE COSTUME.

had to expect. At Camp Ridley (the name given by Mr. Borchgrevink to the settlement) the wind attained a velocity of 87 miles an hour. Meteorological observations were taken every two hours, day and night, and magnetic observations whenever the conditions were favorable. Geological specimens were collected from Cape Adare, and the doctor made microscopic investigations of the blood of the members of the expedition.

On April 22 Mr. Borchgrevink made the first attempt to penetrate into Robertson Bay on the ice, which was there about 2½ feet thick. All round the bay the land rose in sheer cliffs several thousand feet high. The expedition almost ended in disaster, and it was only with the greatest difficulty that the members of the party succeeded in returning to Cape Ridley. The discovery that fish could be caught was welcome, and fish and seals formed an unexpected addition to their supplies. There were tremendous gales, and the difficulty of taking meteorological observations proved almost insuperable, the observer finding it necessary to visit the station with a rope round his waist. On one occasion Mr. Evans was lost in the blinding snow drift for three hours, and men and dogs alike suffered greatly from frost bites. During July several small sledge journeys were accomplished on the coast of Victoria Land, and depots were made at several places along Robertson Bay.

DUKE OF YORK ISLAND.

On one of these expeditions over the ice an island was discovered, which Mr. Borchgrevink named Duke of York Island. The coast line was investigated and a valuable geological collection made. On the journey back to Camp Ridley in August the lowest temperature was recorded —52° F. August and September were spent in expeditions in the neighborhood, but the great height of the land made it impossible to reach the interior; near Robertson Bay, for example, it reached nearly 12,000 feet. Immense glaciers precipitated themselves into the sea, sometimes at an angle of 50°, crossed by innumerable crevasses, making the coast expeditions both arduous and dangerous. For seven weeks the camp was established in the neighborhood of Mount Sabine, and great difficulty was experienced in maintaining communication between the two camps. The Finn Savio nearly lost his life by falling into a crevasse on one of the glaciers of Victoria Land. With incredible difficulty, however, and the aid of a strong knife, with which he cut footholds in the ice, he managed to reach the top. Both Duke of York Island and a district of great geological interest which Mr. Borchgrevink named Geikie Land, proved to be rich in minerals. Soon after his return from one of these expeditions, on October 15, Mr. Hanson died. On that day the first penguin had returned,

BIRD'S-EYE VIEW OF OLD TEHERAN.

and on November 3 the party enjoyed their first feast of eggs. The peninsula by that time was swarming with penguins, of which a constant stream could be discerned far out on the ice. With short interruptions heavy gales, some reaching a velocity of 108 miles an hour, were experienced.

In the Antarctic the explorer is without many of the aids on which the Arctic explorer may reckon. There are no bears, foxes, musk oxen, or reindeer; and accordingly nearly double the quantity of provisions must be taken on an expedition of a given distance. The powerful gales, too, make it not only impossible to travel for long periods, but difficult to exist at all. The great heights of Victoria Land and the enormous glaciers present almost insuperable difficulties to explorations of the interior. Up to the middle of November very little change was to be seen in the general ice pack, although some open channels were met with on a sledge journey made by Mr. Borchgrevink and one of the Finns to the east of Cape Adare, principally for the purpose of studying the ice conditions. The channels, however, closed again, and it was not until the end of November that any noticeable change took place in the ice pack. Immense numbers of birds were by this time congregated on Cape Adare, and a magnificent collection of eggs was made. The small party, after its long detention, now began to look forward to the return of the "Southern Cross." Preparations made for taking observations of the total eclipse of December 3 were rendered useless by the day's being overcast. The last sledge expedition started on December 10, mainly for the purpose of collecting eggs. The day was marked by an interesting discovery by Dr. Kloostad, who found among the mosses on Geikie Land a number of insects of three distinct types, of which on his return to Camp Ridley he made some excellent microscopic investigations. Christmas was passed in festivity, and two days later no ice was visible, even through the telescope, toward the north, although to the west and northwest considerable quantities were seen.

About this time the young penguins began to hatch out, and Mr. Evans collected specimens of the young birds at various stages of growth. By January 10 open water was everywhere to be seen, and the weather was appreciably warmer. Expeditions were made in the kayaks, and on February 28 the "Southern Cross," her masts and yards covered with ice, arrived. Stores and collections were rapidly embarked, and on March 2 the vessel steamed away from Cape Ridley. Mapping the land as they passed, wherever it was possible, Mr. Borchgrevink landed on Colman Island and collected specimens of the rocks and vegetation. On March 6 a

THE PULI-MENSCHILL BRIDGE BETWEEN KESCHT AND TEHERAN.

landing was effected on the mainland, where a fine camping ground of about 100 acres was discovered. Magnetic observations were from time to time taken, landings effected, and specimens obtained. The marine fauna was investigated and photographs were taken.

THE BIRTH OF AN ICEBERG.

A landing was made at the foot of Mount Terror, and here Mr. Borchgrevink and Captain Jensen narrowly

escaped death. Three others of the party had returned to the ship. As they were collecting specimens the two explorers heard an overwhelming roar. Mr. Borchgrevink's first thought was that the overhanging rock was coming down. The next moment, however, he realized that the glacier immediately to the west of the little track on which they stood was giving birth to an iceberg. With a deafening roar, the huge mass plunged into the sea, and a white cloud of water and snow hid everything from their eyes. A wave rose like a wall from the plunge of this gigantic ice mass and seemed to grow rapidly as it approached the low ledge where they stood. Instinctively they ran to the highest part of the beach and stood close to the perpendicular mountain wall. The time seemed long drawn out. The wave first struck Mr. Borchgrevink; lumps of ice were driven against his back; he felt the blood rush forward from beneath his nails as he clung to the rock. The icy water passed over his head, and when it receded Captain Jensen was still by his side. Several waves followed in succession, but none so high as the first. Had it not been that the strength of the wave was partly broken by a projecting ice slope, they would undoubtedly have been smashed against the rock. The water marks showed that the first wave had reached a height of 20 feet above their heads. From this point a southerly course was taken, and great cold was experienced. On the 17th of the month, when in latitude 78° 34' S. and longitude 195° 50' E., a break in the ice barrier was discovered, and, leaving the vessel in charge of Captain Jensen, Mr. Borchgrevink effected a landing, and, accompanied by Lieutenant Colbeck and the Finn Savio, proceeded southward, reaching 78° 50', the farthest point south ever reached by man. On their return to the ship the homeward voyage was commenced, and Stewart Island was reached on April 4.

The president, in thanking Mr. Borchgrevink, expressed his opinion that valuable results had been obtained, and the best line of investigation followed. The meteorological notes, extending over a whole year, would be most valuable. It would appear that the barrier of southern ice had since Ross's time been broken through to the extent of about 36 miles. He had great hope of ultimate penetration into the southern continent. He moved a vote of thanks to Mr. Borchgrevink for his paper, to the members of his staff who were present, and to Sir George Newnes.

ADVANCEMENT OF ELECTRICAL CHEMISTRY.

In the year 1800 Nicholson and Carlisle showed that water could be decomposed into oxygen and hydrogen by means of a "volta pile"; since that time the electrolytic decomposition of water has been employed as a lecture experiment to show the composition of water. It is, however, only quite recently that oxygen and hydrogen have been produced on a manufacturing scale by the electrolysis of dilute solutions of caustic soda or sulphuric acid. The hydrogen so obtained is usually almost absolutely pure, but the oxygen is generally mixed with about 3 per cent. of hydrogen, which, however, can be removed by passing it through red-hot tubes.

The powerful oxidizing action of ozone has through the advancement of electrical science been pressed into the service of the manufacturer. The methods employed for its production are all more or less based upon the well-known Siemen's tube. Generally speaking, air and not oxygen is ozonized, the air to be ozonized being freed from dust and from excess of moisture, the last of which causes formation of hydrogen peroxide. The temperature should be kept as low as possible, because at low temperatures oxides of nitrogen are less liable to be formed and the quantity of atmospheric oxygen converted into ozone is increased; indeed, some manufacturers cool the air down to 4° C. before subjecting it to the electric discharge. For convenience of use the ozone is generally compressed into iron cylinders under a pressure of from four to five atmospheres. It is used for refining and bleaching linseed and palm oils, and for the manufacture of oxidized oil for linoleum. Brewers are often troubled with fouling of the beer barrels; this seems to be due to the growth of a fungus which often penetrates the wood to a considerable depth, so that ordinary methods of cleansing fail to remove it. The oxidizing action of ozone has been successfully employed to remove this growth, the method being to alternately steam and ozonize the casks. It has also been utilized to remove fusel oil from alcohol, in the purifying of water, the refining of sugar in place of animal charcoal, and in a great variety of other manufacturing processes.

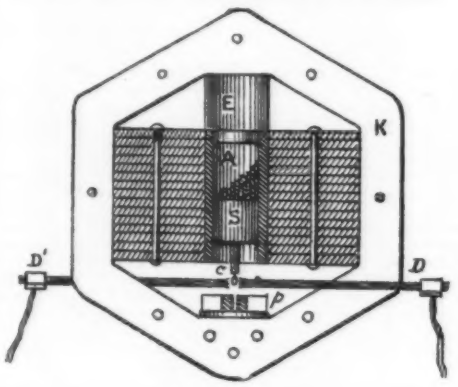
It is well known that synthetical diamonds have been obtained by means of the electric furnace; charcoal obtained from sugar is rammed into a wrought iron cylinder, which is then closed with a plug. The cylinder so filled is placed in a bath of molten iron kept at a high temperature in an electric furnace, after which the crucible which contains the iron is rapidly cooled by immersion in molten lead. On dissolving the iron in acid minute diamonds are obtained. It was a question whether here we had a case of simple crystallization of the carbon from the molten metal on cooling, or whether the enormous pressure which was exerted upon the interior of the mass by the rapid cooling of the outside acting upon the carbon at a high temperature caused the formation of crystals of diamond. An exceedingly ingenious experiment which has been carried out by Majorana shows that at any rate the influence of high pressure and high temperature combined is sufficient to convert amorphous carbon into the crystalline variety. Majorana's experiment is as follows:

A cylindrical chamber, *A*, is hermetically closed at the top by a solid block of iron, *E*, the bottom by a solid piston, *S*. The sides of the chamber are made of tempered steel, and to further strengthen it the chamber is surrounded by fifteen iron rings 1 centimeter thick, which are bolted together. The whole system is placed within a hexagonal frame, *K*, also made from iron plates. The piston, *S*, has a small solid iron cylinder about 1 centimeter in diameter attached to it, at the end of which is fastened a small piece of carbon, *C*, about 2 grammes in weight. Directly below the piston a thick block of iron, *p*, is fixed, into which a hole exactly the size of the small end of the cylinder has been drilled. In carrying out the experiment the carbon is heated by means of the two carbon poles, *D*, *D'*, with a current of 25 amperes and 100 volts. When the carbon has become a white-hot, 70 grammes of gunpowder contained in the chamber, A, is exploded, the piston being driven down, carrying the heated carbon before it and compressing it with enormous force. On taking the system to pieces the carbon is found to have been partially converted into microscopic diamonds, which when freed from unchanged amorphous carbon are found to possess all the characteristics of natural diamonds.

Reference has already been made to the importance of the manufacture of calcium carbide; another carbide, that of silicon, is now being manufactured in considerable quantities, and, owing to its extreme hardness, is being employed in place of emory for polishing steel and making grindstones. This carbide, which goes under the name of "carborundum," is manufactured by means of the electric furnace. An American company at Niagara Falls employs furnaces capable of dealing with ten tons of material, consisting of coke, sand, common salt, and sawdust, which yield two tons of carborundum in twenty-four hours. In the first half of the year 1897 it is stated that in America alone 750,000 pounds of carborundum were manufactured. Since the introduction of electricity to chemistry the carbides of almost all the metals have been obtained, the majority naturally being more of theoretical than of commercial interest.

From the days of Leblanc, the founder of the soda industry, perhaps no branch of inorganic chemistry has been more worked at, or has better shown the results of patient toil and inventive genius, than the alkali and bleaching industry. Only after many attempts and many failures has the seemingly simple task of electrolysing sodium and potassium chloride yielded results which have enabled electricity to enter into competition with the former method of manufacture.

According to the manner in which the electrolysis is conducted, a solution of potassium chloride may be converted into chlorine and caustic potash, potassium hypochlorite, or into potassium chlorate. If the electrolysis takes place at low temperatures, a solution of hypochlorite is obtained, which may without further treatment be used for bleaching purposes. The difference in price between this solution and a solution of bleaching powder is not very great, but the greater cleanliness and purer bleaching action of potassium (sodium) hypochlorite make it, when electric power can be easily obtained, at least a powerful competitor with



bleaching powder. When the electrolysis is conducted at temperatures from 60° and upward, the bath being kept slightly alkaline by addition of potassium bicarbonate of lime, potassium chlorate is produced, which, owing to its slight solubility in water, crystallizes out, and by washing is readily freed from adhering chloride.

If caustic potash and chlorine are required, some arrangement must be made to prevent the liberated chlorine from again reacting with the caustic potash formed at the same time. Formerly, and still to a small extent, this was arranged by means of a diaphragm which separated the anode from the kathode. Owing, however, to the difficulty of obtaining a pervious impervious diaphragm, i. e., one which allows the current to pass but is impervious to the solution, it is now more general to electrolyze without a diaphragm. The method employed is one which was originally employed by Castner and Kellner, the kathode being a layer of mercury at the bottom of the bath. On the current being passed, the potassium liberated at the kathode dissolves in it, forming an amalgam, which as it is formed is drawn off and run into pure water, the water being decomposed, assisted by an auxiliary current, with evolution of hydrogen and formation of caustic potash, which is obtained in the pure condition by evaporation. Carbonate of potash may be prepared by passing a stream of carbonic acid gas into the caustic liquors before evaporation. In commerce, naturally, it is more general to electrolyze the cheaper sodium chloride, at any rate, in this country. Strontium and barium chlorate are also manufactured by electrolysis of their chlorides.

It has been found possible to prepare painters' colors by electrolysis, e. g., "white lead" is obtained in a very pure condition by electrolyzing a dilute solution of sodium chlorate and carbonate, the electrodes being of lead. If the sodium carbonate is replaced by sodium chromate, a neutral lead chromate is produced, an acid chromate being formed by cautious addition of a solution of chromatic acid during the electrolysis.

To attempt to mention, much less to describe, the enormous number of inorganic compounds and elements which have been prepared or isolated by the aid of electricity, would be, in an article such as this, impossible; but sufficient examples have been given to show the importance of electrical processes in this branch of chemistry.

Turning now to organic chemistry, we notice that, although a vast amount of work has been done, it is more of theoretical interest than of technical value. But now that the initial difficulties have been to a large extent overcome, and the manner in which the reactions take place is better understood, it is probable that shortly this branch of manufacturing chemistry will also undergo a revolution in the hand of the electro-chemist. As a means of synthesis and of proving the formula of substances, electrolysis has been, and is, of great value to the organic chemist. Thus on electrolyzing a solution of an alkaline acetate, ethane is produced; whereas by employment of a succinate, ethylene is formed, a solution of fumaric acid yielding acetylene. These are, of course, simple cases; but even that seemingly unsolvable problem, the constitution of camphoric acid, has been attacked by Walker, and by means of electrolysis of it and its derivatives he has obtained results which must be of great value in ultimately deciding what is the correct formula for this substance.

Iodoform can now be produced in a state of great purity by electrolyzing a solution of potassium iodide and sodium carbonate to which alcohol has been added. On electrolysis, employing electrodes of platinum, iodine is continually set free at the anode, and coming in contact with the alcohol at the moment of its liberation produces iodoform. As the reaction proceeds some of the iodine becomes converted into hydriodic acid, and this combines with the alkali liberated at the kathode, or which has been added to the bath, potassium iodide being regenerated, which by the further passage of the current is again split up. The process is a continuous one, the iodoform being from time to time removed and a further quantity of alcohol, potassium iodide and sodium carbonate added. It is interesting to note that the alcohol cannot be replaced by acetylene, as in this case only a very small quantity of iodoform is produced. Chloroform and bromoform have not been successfully prepared by this method. Chloral can, however, be produced by electrolysis of a solution of potassium chloride at 100°, to which alcohol is from time to time added.

By the electrolysis of nitrobenzine in a strongly acid alcoholic solution, aniline is produced. If the nitrobenzine is suspended in concentrated hydrochloric acid, ortho- and para-chloraniline are formed. By electrolysis under other conditions, azobenzine, hydrazobenzine or azoxybenzine are obtained.

By the electrolytic oxidation of aniline, dye products can be obtained the nature of which depends upon the solution employed, the strength of the current, and the material of the electrode, e. g., if an aqueous solution of aniline hydrochloride, which may be either acidified with sulphuric acid or be practically neutral, is electrolized, platinum electrodes being employed, a green precipitate is produced at the anode, which becomes violet, bluish-violet, and finally almost black, practically the theoretical quantity of aniline black having been formed. If the aniline contain toluidine, then mauveaniline, rosanile, etc., are produced.

Attempts have been made to obtain alizarine by electrolysis of anthraquinine in strong alkaline solution; indeed, small quantities are said to have been obtained.

It has even been found possible to utilize electricity in the dyeing of cloth. When, e. g., a piece of cloth is soaked in a solution of aniline sulphate and placed between two metal plates, which are connected with opposite ends of a dynamo, and the current passed, the aniline sulphate is converted into aniline black; indeed, by alternating the strength of the solution and the density of the current, shades varying from green to deepest black can be produced.

In the case of indigo the cloth is thoroughly impregnated with a thin paste of indigo-blue and caustic alkali; it is then placed between two metal electrodes. On the current being passed, the insoluble indigo-blue is converted by reduction into the soluble indigo-white, which on exposing the cloth to the action of air becomes again oxidized and the material dyed blue. Patterns may be printed on the cloth by cutting or stamping the plates in relief, or by connecting one pole to a metal plate and the other to a metallic pencil, when patterns, etc., can be readily sketched upon the material (Goppelsroeder).

Such processes as have been described in these articles appear, when seen in print, as extremely simple. Theoretically, they may be so; but in practice, the carrying out of these seemingly simple operations is often attended by great difficulties. For example, the temperature must not be allowed to rise too high or fall too low. The quantity of current and its potential require often to be kept within extremely narrow limits, as the following simple example illustrates.

Silver and copper can be separated by means of electrolysis, the silver alone being deposited if a very low current density (·10 ampere) is employed, whereas with a higher density (·50 to 1·0 ampere) the copper is deposited. Naturally, then, if at the commencement of the operation the higher current density is employed, both metals will be deposited together. Many of the difficulties to be overcome are to a large extent engineering. And it is to a considerable extent due to collaboration of chemists and engineers that the science of electro-chemistry has become what it is.

Electro-chemistry is quite in its childhood, but it is making marvelous and rapid progress. Works dealing with technical chemistry but a few years old require to be revised, owing to the alterations which this branch of chemical industry has brought about.

It is humiliating to realize that in this country [England] there is hardly a book on the subject to be obtained, and in most cases even these are only translations from Continental works. And it is to be feared that unless this branch of chemistry becomes more studied than it has been up to the present, we shall find in the near future that electro-chemistry, both theoretical and practical, is the property of America and the Continent.—F. Mollwo Perkin, in Nature.

TOURISTS IN SWITZERLAND.

Consul Ridgley, of Geneva, on October 31, 1899, writes:

It is estimated that since January 1, 1899, up to the present date, no less than 2,600,000 tourists have visited Switzerland, and that they have each left in the country an average of 80 francs ($15.44) or a total of $38,600,000. Inasmuch as the population of Switzerland is only 2,933,300, it is not difficult to appreciate the significance of these figures. The per capita wealth of the country has heretofore been estimated at $14; but the influx of money above referred to suddenly brings it up to

$29.45, or from one of the poorest countries (per capita) to one of the richest. This, at least, would appear to be the result on paper; but as a matter of fact, the sudden increase of the country's wealth is not so great as the figures would indicate, for the reason that Switzerland buys nearly everything she sells to tourists, including the supplies for the hotels and boarding houses, and, therefore, while a great deal of money comes into the country a large proportion of it has to be paid out. However, the increase in the country's wealth from the tourist movement during 1899 is notable, hotel keepers being the largest beneficiaries.

SOME OF THE RESOURCES OF THE PHILIPPINES.

By G. D. RICE.

IT is now quite generally known that the Philippines have such minerals as iron, gold, silver, copper, lead, granite, petroleum, limestone and quartz, and that it is only a matter of time when these minerals will be mined and put into the commercial markets of the world. Long before the Americans first came here to engage in war, a great many foreign prospectors were surveying lands and staking off claims with a view of eventually establishing plants for the working of the minerals of the islands. Since the Americans have been here, and the cities and towns have been properly garrisoned, small parties of Americans and others have organized for the purpose of prospecting for gold in the hills. These small outfits are usually gone from one to two months, and ordinarily report back with information concerning the existence of gold in placer deposits and in veins or ledges. Very often some nuggets are brought in by the men, but as yet all work is done on such a small scale and attended with so many hardships that there is no money in it. One party which went out from Iloilo on the Isle of Panay, crossed over the mountains to the opposite side of the island, prospecting as they went, and located indications of the presence of valuable metals in places where white men never trod before. The party was obliged to go afoot nearly the entire distance, leaving their horses behind at Passi, for the trails could not be traversed by any four-footed animal.

The grasshopper eaters were met with in the mountains, and quantities of the grasshoppers were seen distributed over mats on the sunny side of hills, in the process of drying out. When the grasshoppers are thoroughly dry they are worked into various forms of dishes, with sweets and cocoanut meat, making what is to the natives a most excellent dish. But these natives seemed to be otherwise intelligent and particular as to their methods of eating and cleanliness, and in time could, no doubt, be trained to be good workers in the rich metal deposits in their country. Most of the natives realize the value of the minerals on their lands, but they are too lazy to work to secure the deposits. If there are indications of gold deposits, the natives habitually work about in the vicinity and obtain what metal can be easily removed from the surface. It is very seldom, however, that they proceed in the effective American fashion for getting out the gold, and consequently they secure very little.

The apparatus at present employed for what little mining is done in the Philippines is very crude indeed. Some of the machinery was made more than 200 years ago, and continues serviceable only because it consists of but few parts, and these are mere pieces of hard wood arranged with split bamboo for a sieve, or a couple of iron rolls in stout hardwood beams for crushing purposes. No doubt, if Americans were to bring the proper kind of modern mining machinery to this country, they could make a great deal of money. The natives have been known to bring down gold-containing quartz from the mountains and exchange it for a few trinkets or pieces of fabric from the stores, not knowing the value of the metal. They have no means for working quartz and are only too glad to exchange a cart load of it for a few dollars' worth of inferior textile goods or fancy articles. The native merchants who procure the quartz sometimes manage to dispose of it profitably to some one who knows its value and who will ship it to some country where the gold can be obtained. Very often, however, the quartz is simply used as relics or ornaments about the native merchant's store and house, he, as a rule, not knowing what to do with it, or its real worth.

Should Americans establish mining enterprises in the Philippines they would be surprised at the cheapness with which good labor may be secured from among the native population. The mountain classes of natives are all strong, and they know what a day's work is. These native young men, having long since tired of warfare, are only too glad to get steady employment at the rate of 25 cents per day, American money. The writer has seen large numbers of native farmers, plantation help and others, engaged in the various industries of the islands, paid off at the rate of only 15 cents per day, American money, and they seemed satisfied with the salary. Usually, when the pay is so low, the owner of the mine, plantation, or manufacturing industry, provides quarters for his help and also furnishes them with rice, the cost per day per man being about 8 cents, American money. One reason why the country has always been at war is the lack of something for the young men to do to keep them out of harm. The native can live without working in this country because a small bamboo shack will afford him lodging, and he can build this himself. He requires only a shirt and trousers for clothing, and for living he can step into a cocoanut or banana grove or a rice field and procure all he wants to eat. This, of course, encourages laziness, and to pass the time away the native young man sometimes engages in war. If there were more mining enterprises in operation, more young men would be given work, and the warring elements would, in time, cease for lack of fighting material. Therefore, the military authorities of the islands are doing all they can to encourage the establishing of mining and general manufacturing enterprises, and if any capitalist were to start mining here he would find that his property would be amply guarded by the military.

The time of working in this country differs from the time in other countries in that the intense heat of the middle of the day prevents hard labor, and usually the natives rest from 11 o'clock in the forenoon until 2 o'clock in the afternoon, and work later at night or begin earlier in the morning to make up for it. They manage to work 10 to 11 hours per day.

One of the most important factors concerning the operation of a modern mining enterprise in any country is the care of and the repair of the machinery. There are from 1 to 5 or more machine shops in every city and town in the islands, but the equipment of machinery in these shops is very limited, and what there is of it is very ancient. They have no boring devices except such as can be worked by hand. There are no planers, cutting tools, turning lathes or anything of the kind, although the Government shops at Manila, Iloilo and other important points have put in some of the most important metal-working tools and machinery. The mining managers would have to bring with them their repairing and constructing machinery and put up a little repair shop of their own.

The principal gold mines are in the province of Camarines Norte, where this metal has already been taken out and sent to other countries for working. The mountain tribes have for many years brought gold nuggets out of these and surrounding provinces, but, as a rule, the natives will not disclose to foreigners the precise locality. In the Island of Mindano there has been considerable prospecting lately, with the result that many parties have returned with encouraging reports of what they saw and what they found. A great many claims were staked off for future working. The leading points at which gold was discovered are in the vicinity of Tagsulip, Misamis and Cuenca. In the provinces of Benguet and Lepanto, both gold and silver were found. On the Island of Luzon gold has been discovered in several places, and usually in profitable working quantities, but lack of proper facilities for handling the output prevented the members of the prospecting parties from doing much more than staking claims and securing samples and descriptions of the conditions. In the Baler Mountains a great deal of gold was located and some fine specimens secured and exhibited. The rivers of Ango, Santa Maria and San Jose contain gold deposits in the sands on their banks.

In the district of Paracale, in Camarines Norte, there is already a profitable copper mine in operation, and there is said to be ample opportunity for establishing additional mines there with the chances of good success.

It was only a few years ago that systematic geological research was begun in the many islands of the Philippines, and the progress of operations has many times been stopped by wars. It was always considered dangerous for prospecting parties to go very far into the mountains, and the bones of many daring men are up in the hills now as a result of going too far into a country where white men were still unknown. Up to the present time only a very small proportion of the country has been prospected by any except the natives, and in most instances the native prospectors would pass right over a mine and not know it, unless there were liberal signs of the metal on the surface. They possess no instruments for testing, and would not know gold when they saw it unless the metal happened to glitter and thus attract their eye. The portions of the islands which have thus far been investigated by trained miners and experienced mining engineers present a very encouraging prospect, and if the metal exists in unexplored sections in the same proportion as they exist in the sections already explored, these islands must be very rich in minerals. There are thousands of extensive unexplored ranges of hills and mountains on all of the islands of the group that probably contain more or less quantities of metals, and which, in time, will be discovered and worked.

There is a plant at San Isidro, Luzon Island, for the working of petroleum, and this article has been found in quantities in the Island of Panay near Iloilo, and on the Island of Cebu. There is a great demand in all of the islands of the group for petroleum oil for lighting and general purposes of cooking. The present cost of the oil is exceedingly high and it is usually sold in bottles, quart bottles retailing at ten cents each, American money. This makes it costly to have lights burning to any great extent, yet the natives use the petroleum oil very freely. Their oil account is often one half their expense of living. Some good oil plants, if established in this country, would bring the price of oil down to the proper level. At present the oil plants in operation can barely more than furnish oil for the markets in their immediate vicinity, and the oil consumed in all other places on the islands comes from Russia and the United States.—The Engineering and Mining Journal.

VALUELESS PRINTED MATTER.

THERE is a bill before Parliament, says The Spectator, introduced at the instance of the trustees of the British Museum, which will probably be thought at first sight to be a very practical and useful measure. The British Museum is a spacious building, but if it were double its size there are limits to the quantity of printed matter it will hold. This limit has pretty well been reached, and as the new arrivals grow more numerous every year the time has obviously come for further enlargement. The trustees, or more probably the treasury, are not anxious to spend public money in giving house room to more books and papes, and in order to avoid this necessity they have asked themselves whether the difficulty may not be approached from the other side. They are, in fact, in a position which is familiar to every London householder who is in the habit of buying books. The books increase, the shelves after a certain point remain stationary. The Museum authorities propose to deal with the problem very much as the householder deals with it. "I cannot move the house," he says; "I must weed the contents of my library." And so he takes counsel with the second-hand bookseller, the buyer of waste paper, and the local librarian, and in the end a cart comes to the door and a portion of the library is either given away or made over to a purchaser.

This is precisely the process which is copied in the British Museum bill. The trustees are first to negotiate with the local librarian, that is to say, they are to deposit copies of local newspapers in their possession subsequent to 1837 with county or borough councils. The possibility that these county or borough councils may not care to accept the gift is apparently provided for in the next clause. This empowers the trustees to "dispose by destruction or otherwise of printed matter not of sufficient value to justify its preservation in the Museum." What better evidence of the worthlessness of an old local newspaper can there be than the fact that no county or borough council will condescend to accept it? Yet the determination to look this particular gift-horse in the mouth is likely to be not infrequently met with. Local institutions get filled up as surely, if not as quickly, as central institutions, and when there is very little space left unused, the offer of a file of old newspapers will probably be declined with thanks. Then the trustees will have to fall back on the more comprehensive permission, and the rejected newspapers will be included in that huge mass of printed matter which is "not of sufficient value to justify its preservation in the Museum." The only check upon the action of the trustees is the provision that nothing shall be destroyed which is of earlier date than 1660, and that lists of the condemned matter shall be laid before both houses of Parliament.

This, we say, is the argument formally put forward on behalf of the bill, and if the British Museum were a private library, or even an ordinary public library, it would be convincing enough. We question, however, whether there are many people who will think this of it after they have read Mr. Sydney Lee's letter in The Times. Mr. Lee does not admit this analogy which underlies the case for the bill. The library of the British Museum exists in order to "house and make easy of access, now and hereafter, in a single building that shall be open to all comers, the amplest materials in existence for purposes of literary, historical, archæological, and sociological research." It is for this reason that every publisher is compelled to send to the Museum a copy of everything that he publishes. No matter is so worthless that the trustees can decline to receive it, and from this it naturally follows that no matter is so worthless that the trustees can refuse to keep it. What is the use of receiving matter if they may destroy it at their pleasure? It would be more reasonable to give them the power of rejecting it when it is offered. For the lapse of time does not make the trustees or their advisers any better judges of what is valuable or valueless. Nothing is of value for the purposes of the historian until the historian arrives. In competent hands the most seemingly worthless matter becomes instinct with illustrative force. Supposing that all the old newspapers, pamphlets, broadsheets, and the like out of which Macaulay built up his history had been dealt with in the way provided in the bill before Macaulay began his work, how much would have survived for the use to which he afterward turned it? How much would have been destroyed as "not of sufficient value to justify its preservation in the Museum?"

It may be urged that no one proposes to destroy old newspapers or pamphlets or broadsheets. They have a value from the mere fact that they are old, consequently they at least will be safe from the hand of the spoiler. It might be answered that the date named in the bill is 1660, so that most of the material which Macaulay found so useful might be withdrawn, if the trustees so willed it, from the cognizance of historians yet to come. We will concede, however, that destruction of this sort is too improbable to make it necessary to guard against it, that materials which have the mark of the historian already impressed on them will be as safe if the bill passes as they are now. But how about future Macaulays? These old newspapers and pamphlets and broadsheets that have become valuable by age possibly seemed as valueless to those who were living when they were printed as contemporary newspapers, pamphlets, and broadsheets may seem to the trustees of the British Museum now.

It is not in the power of any one to say which of them will have value hereafter. They are printed for a momentary purpose, and when that momentary purpose is served they pass into deserved obscurity until they are dragged back to light by the historical or archæological student. In his hands they assume a wholly new importance. The object for which they were written has passed out of recollection, but they help to explain and reproduce the mental condition of the nation to which they were meant to appeal. Mr. Lee speaks with special authority on this subject. The "Dictionary of National Biography," with which he has been associated from the beginning, owes its existence to "investigations which have been largely conducted in the British Museum. The newspapers and the valueless printed matter which it is now proposed either to destroy or to remove elsewhere have proved of the highest importance in tracking out or in testing numberless pieces of pertinent information." If this bill passes, no future dictionary can be sure of enjoying the same opportunities.

BANANA FLOUR.

THE banana, which grows in almost all tropical countries, is very nutritive, and forms a nearly perfect food. It contains more than 25 per cent. of assimilable organic matter. According to Humboldt, it is forty-eight times more nutritious than the potato, while Crichton Campbell has stated that the banana is twenty-five times more nutritious than the best wheaten bread. The analysis of Thoms shows the presence in the flour of banana of 9·01 per cent. of nitrogenous matter. The best wheaten flour contains no more than 9 to 11 per cent. It is preferable to manufacture the starch from unripe fruits, because the starch is converted into sugar in ripening. In Venezuela the flour of the banana is given especially to children; it is equally good for aged people, convalescents, nursing women, and is of great service in the feeding of those suffering from complaints of the stomach. In Central America, Colombia, and Venezuela, the banana flour is prepared on a large scale, and sold under the name of Musarina. The flour of the banana may be used in the same way as wheaten flour, except for the preparation of bread, for which it is unsuitable, inasmuch as it contains no gluten. Various formulæ are taken from the Tropenpflanzer for preparing banana flour for dietic use. Thus a teaspoonful of the flour in a cup of chocolate or cocoa facilitates the digestion of these drinks, and renders them more nutritious. This addition enables cocoa to be taken by those whose stomachs are in a weak state. A sustaining drink may be made by adding a teaspoonful of the flour to an egg yolk beaten up, mixed with milk, and sweetened with sugar. The

sale of banana flour in London is insignificant, on account of its high price and the fact that its uses are not yet understood.—Revue des Cultures Coloniles 6, 53.

THE FLAX INDUSTRY OF COURTRAI

THE town of Courtrai ranks second among the commercial and industrial centres of the province of Flanders, and at the commencement of 1898 had a population of 33,128. Consul General de Courcy Perry states that the exceptionally favored situation which Courtrai occupies on the banks of the river Lys, in the midst of the flax retting district, is certainly the main cause of the town's prosperity, but in addition to the flax trade, other important industries exist in Courtrai and its neighborhood, and gives the whole district a character of brisk and flourishing business activity. The success which attends the manufacture of flax at Courtrai may be attributed in a great measure to certain properties possessed by the waters of the river Lys which imparts to the flax a remarkable fineness, or spinning quality, combined with extreme tenacity. The peculiar virtues with which nature has endowed this stream would appear to have baffled scientific research. Continuous efforts have been, and are being made by scientific men, especially in Russia, to ascertain the nature of the chemical components to which the Lys owes its rare qualities, but their endeavors have so far proved unavailing. This sluggish and apparently insignificant river thus possesses what may be called a unique monopoly, and on account of the great benefits it confers upon the district through which it flows has been well styled the "Golden River." The special properties of the Lys do not extend throughout its entire course, but are confined to that portion of the stream which flows between Comines (Pont Rouge) and Deyaze (Barrierè d'Astère). From Comines to Menin the Lys flows midway between the North of France and West Flanders, but it is between Menin and Vine St. Eloy that the retting is principally carried on, and at Weveighen, half-way between Menin and Courtrai, the industry reaches its culminating point. The demand for the flax prepared in the Lys has greatly increased during the last ten years, and the amount of fibre brought for treatment in that river becomes annually larger. The local crop no longer suffices to meet present requirements, and immense quantities of flax arrive from foreign countries, especially Holland and France. Of late years small consignments of flax have also reached Courtrai from the Argentine Republic. The quantity of flax straw retted in the river Lys last year was estimated at about 90,000 tons. Some 12,000 to 15,000 laborers were employed during the six months from April 15 to October 15—that is to say, the season during which retting takes place. After the retting processes are finished, the flax is stored in barns and sheds until winter, when the scutching, that is cleaning the fiber of the woody parts, takes place. This was formerly all done by hand, but at present steam-power is greatly used, and much is also done by a sort of treadmill. About 10,000 tons of scutched flax were sent in 1898 to Great Britain and Ireland, the greater part going to the latter country. Other countries, such as Germany, Austria, Russia, France and America received the remaining portion of the flax exported. The Belgian spinning mills also take a small quantity. During the 1896-97 season, which may be taken as an average year, the value of the flax exported from the Courtrai district was 30,000,000 francs (£1,200,000). The shipments for Great Britain and Ireland take place through the port of Ghent by the direct Ghent-Belfast route and other regular lines. It is a curious fact that although Courtrai excels preeminently in the retting and dressing of the flax fibre, spinning is carried on there only to a very limited extent. Weaving has been carried on since an early date at Courtrai, and in former times the name of the town was identified with some of the finest woven fabrics in the world. This industry is still actively carried on. The old method of hand weaving still flourishes, but a large quantity of fabric is also produced by the mechanical process. Machine weaving was founded many years ago in the Courtrai district, and its extension and development were somewhat slow; but ten years ago a considerable number of manufacturers interested in hand weaving realized that in certain branches of the industry the struggle against mechanical process was hopeless, consequently they yielded to the stress of circumstances and founded large and well equipped machine-weaving establishments that have steadily prospered up to the present time. The number of machine-weaving factories in the Courtrai district now amounts to about 20; the number making use of the old hand loom system is, however, much larger.

HOW QUININE IS RAISED.

THE quinine plantations, or quinales, as they are called, which have been started in this country by the Germans, are usually found on rough and broken mountain sides and at altitudes of three or four thousand feet above the sea. The trees will grow at a height of eight thousand feet, but they flourish best at an elevation of about four thousand, for they require a great deal of sun, rain, and wind to reach perfection.

Most of the groves have been raised from the seed, which is gathered in the early summer months and planted in hothouses. When the plants are about six inches high they are transplanted upon hillsides which have been cleared of underbrush and plowed up beforehand, so that the young roots can secure the benefit of all the moisture and plant food in the soil and the heat of the sun. For shelter they are partially covered with twigs, straw, or other light stuff, which also serves to keep the moisture and heat in the ground. After two years this shelter is raked off, the plants are carefully inspected, and those which are not promising are replaced by new ones. The ground around them is kept clear of weeds, and the young trees are carefully trimmed twice a year. In five or six years the tree will have reached the height of twelve or fourteen feet, and its trunk will be straight and slender. It resembles the orange tree in size and shape and the peculiar gloss of its leaves.

Two or three times a year three or four strips of bark about two inches wide and from two to eight feet long are cut from the trunk and thrown upon a paved yard to dry, where, as the moisture evaporates, they curl up like cinnamon. Within a year or so nature replaces the bark that has thus been stripped off and the tree is stripped again in other places. As it grows older smaller strips can be taken from the stronger branches, and a mature tree will produce an annual average of about four pounds of bark.

The bark dries in a few days and is packed for shipment in rawhide bales. Most of it is shipped from Arica and Mollendo.—Lucre (Bolivia) letter to The Chicago Record.

THE PANORAMAS OF THE EXPOSITION OF 1900.

THE panoramas at the Exposition are numerous. All are not of the same importance, however; and some

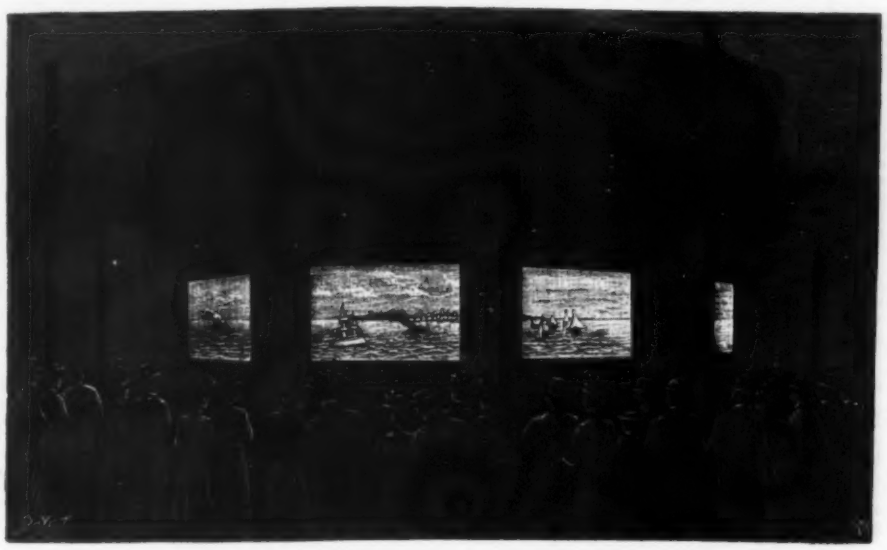


FIG. 1.—STEREORAMA—VOYAGE FROM BONE TO ORAN.

are rather dioramas which complete the exhibition of the products of this or that country, such, for example, as the diorama of Bosnia-Herzegovina. At the Alpine Club, we find the semi-panorama showing Mont Blanc as seen from the Mer de Glace and a few small dioramas of the Vosges, Dauphiny Alps, Pyrenees, etc. Further along, we shall have something of the execution of these canvases, in which photography plays a very important role.

As regards complete panoramas, we may mention that of Scheidegg at the Swiss Village; that of Algiers near the Champ de Mars station; that of Madagascar in the center of the exposition of this colony; and that of the Tour de Monde, the interest of which does not correspond with the importance of the structure that affords it shelter.

As a general thing, in almost all the installations of this sort of spectacle, we feel that the space is limited and that the back canvas, too near the spectator, does not give him a complete illusion of reality.

We have mentioned up to the present only inanimate pictures—those embraced in the category of the ordinary panoramas that we have known for a long time; but there are others in which it has been the desire to give the impression of motion. To this effect recourse has been had to the optical illusion well known to travelers who, being seated in an immovable train, are persuaded that the latter is moving when another train flies past it.

In order that such an effect may be produced, the eye must not be able to make a comparison with the ground or with the objects situated in the distance. The line of sight must be limited to the parts in motion. This principle has been applied in different ways. In the "Stereorama," the travelers are supposed to be placed in the cabin of a boat, and, in the "Trans-Siberian," they are aboard a train of palace cars. The "Cineorama" transfers them to the car of a balloon, and the "Mareorama" upon the deck of a trans-Atlantic steamer having a pitching and rolling motion. In all cases it is the canvas that moves.

In the stereorama by MM. Francovich and Gadan (Fig. 1), the spectator is placed in a semicircular, dark passage. His view is limited by a series of windows formed in a thick wall, and, in stopping in front of one of these, he sees the whole of the Algerian shore, from Bone to Oran, pass before him.

At the start, the sun rises upon a very calm sea, and then, gradually, as Bougie is being approached, billows form, and small white-crested waves make their appearance. In front of Algiers the sun shines with all its brilliancy, and the panorama of the city extends to the horizon with its white houses and its minarets. Oran is reached at sunset. During the entire voyage, the aspect of the sea is constantly changing. In the interim, the spectator sees fishing smacks and a large mail steamer, and then an imposing squadron in sailing order, with all its battleships, cruisers, and torpedo boats. The smoke of the funnels is remarkably real.

The scenery in this stereorama is painted upon the external surface of a cylinder, which rests upon a circular plate much greater in diameter, so as to form a wide flange all around. The whole would be pretty well represented by a high hat. It is provided with wheels which run over a circular rail; and an electric motor causes the whole to revolve. As the spectator has no fixed datum point, he finally thinks that he himself is moving. Upon the wide flange just mentioned are concentrically arranged forty vertical bands of iron plate (Fig. 2) a few inches in height, which are supported by iron rods and rise in steps one above the other. Upon these bands are painted the billows, and to the bands the ships are also fixed. In order to reproduce the smoke of the stacks a very ingenious artifice is employed, which consists in painting very thin glass plates and placing them at different distances one behind another.

FIG. 2.—ARRANGEMENT OF THE MECHANISM FOR PRODUCING WAVES.

The trans-Siberian panorama, erected by the International Sleeping-Car Company, near the Russian and Chinese expositions, is presented in a particularly interesting manner. The spectator is seated in genuine cars of the company (Fig. 3). There are only three of these, but they are 65 feet in length and comprise saloons, dining rooms, smoking compartments, buffets, bed rooms, toilet rooms, a kitchen completely arranged to satisfy the most exacting gourmets, a hair dressing room, and a bathroom to which is annexed a gymnasium. The whole is complete, luxurious, and comfortable. Each of the cars cost $24,000. A small electric works comprising a De Laval turbine actuated by

a dynamo is installed in a baggage car to furnish light for the trains in service. In order to admit a larger number of persons, a free space has been left in front of the cars.

To give the visitor the impression of a genuine voyage, there are made to pass before him such remarkable things as he would see upon a journey from Moscow to Pekin (say a distance of 5,745 miles). We have already given the details of construction of the trans-Siberian and shall surely have to return to it; but for the moment, we desire to occupy ourselves with what visitors may see at the Exposition. When a person is

FIG. 3.—THE TRANS-SIBERIAN—ARRANGEMENT OF THE FOUR CANVASES AND THE CARS.

on a railway train, he does not see all the points of the landscape unfold themselves with an equal speed. In the foreground, the ballast flies rapidly under his eyes, then the bushes and shrubs at the side of the road move a little less quickly, the more remote houses and trees still less quickly, and, finally, the distances unfold themselves quite slowly. It was this result which the inventors endeavored to obtain. In a large trench excavated along the entire length of the building is arranged the mechanism that carries along four distances of the landscape at different velocities (Fig. 4).

In the foreground may be seen the train of gearings, *A*, and the rollers, *B*, that carry along the part, *C*, through friction. At *E*, *F* and *H* are shown the portions of the canvas concealed from the spectators.

The part nearest the car represents the ballast. It is a canvas having the form of a wide horizontal transmission belt (Fig. 3) 197 feet in length, upon which is glued sand and pebbles. It is carried on each side by an endless chain, which is actuated by pulleys to which a continuous rotary motion is given by an electric motor. In order to deaden the noise, there is interposed between the chain and the pulleys a hemp cord, which follows the motion of the chain.

At a slight distance back of this canvas there is arranged another and vertical one. It is upon this that

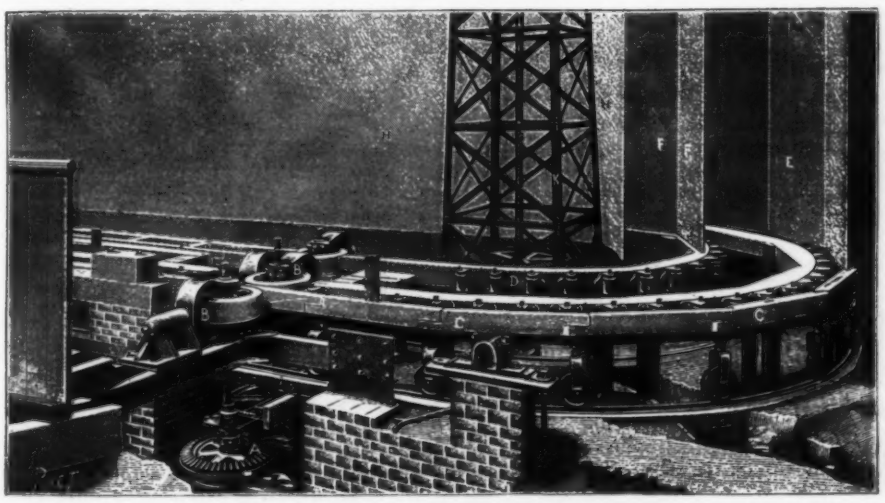


FIG. 4.—DETAILS OF THE MECHANISM FOR MOVING THE CANVASES AT DIFFERENT VELOCITIES.

are painted the bushes and shrubs that border the track. It is supported here and there by uprights of which the base is set into a frame forming a sort of endless car. Held between rollers, *B*, which have a continuous rotary motion, it is carried along through friction indefinitely. The next distance is arranged in the same manner, but the canvas is a little higher and moves less rapidly. Finally, the last distance is formed of a canvas 722 feet in length and 26 feet in height, which is suspended by the upper part from an endless chain supported by rollers that run over a rail. As the building is but 197 feet in length, and it is necessary, without unwinding the canvas (since it must always move in the same direction), to obtain a length of 722 feet, the rail is bent upon itself, as shown in the diagram in Fig. 5, which gives a general idea of the installation. This rail is supported by an iron frame, at each extremity of which is situated a pylone (Fig. 4) that carries a horizontal wheel upon which runs the chain. Only one of the wheels is a driver. A transmission shaft, *G*, running through the center of the pylone, engages beneath the ground with the general transmission. The ballast travels at the rate of 984 feet per minute, the second canvas at 393·6, the third at 131·2, and the back canvas at 16·5 only. The decorative painter Jambon has represented thereon the principal cities, such as Moscow, Omsk, and Irkutsk, the banks of the Baikal, the great wall of China, etc., and, finally, Peking. The entire trip consumes 45 min-

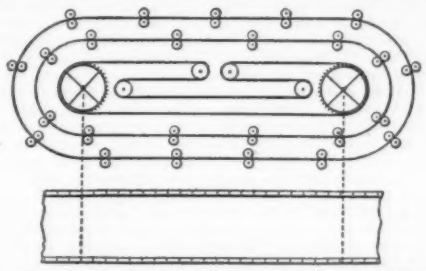


FIG. 5.—DIAGRAM OF THE INSTALLATION OF THE DIFFERENT MOVABLE CANVASES.

utes; but what is peculiar is that the same landscape never presents itself absolutely in the same manner, since, as the velocities are different, the same objects of the different canvases are never superposed twice in succession.

For the above particulars and the illustrations, we are indebted to La Nature.

DESICCATED DRY PLATES.*

IT is well known that dry plates, as ordinarily used, retain a considerable percentage of water, mainly in molecular combination with the gelatine. I find that the presence of this water in the film at the time of exposure has a large influence on the image, all the chief characteristics, i. e., definition, detail, density, speed, time of development, etc., being affected. Moreover, very small differences, in the quantity of this moisture materially affect the result, so that negatives vary with the atmospheric conditions, as to temperature and humidity, at the time of working.

The drier the film, the better the definition and the greater the power of rendering fine detail; in lesser degree, the greater the speed and facility of developing density.

This property of the film can be utilized by desiccating plates for work where definition, detail brilliancy, or maximum speed are desired, and in exposing plates wet where softness of image or the destruction of small textures and details are sought for. Extra rapid plates or orthochromatic plates, in which the former of these qualities are usually found lacking, gain them when thoroughly desiccated to an extent hitherto only found in wet collodion or other specially prepared films.

A perfectly flat-topped kettle containing boiling water is a convenient appliance for desiccating plates. They are simply laid on the flat top of the kettle with a piece of bibulous paper between to equalize the heating, and kept there a few minutes at a temperature of 200° before being placed in the slides, or a thick copper slab with an asbestos cover can be used. Too great or too prolonged heating will crack the film or induce fog.

Desiccated plates have been (with increasinging satisfaction) in daily use here at the Polytechnic for several months past and are already widely adopted in the trade and for scientific work.

* A paper read before the Photographic Convention of the United Kingdom, by E. Howard Farmer, British Journal of Photography.

SURVEYING AND RECONNOITERING WORK OF THE RUSSIAN ENGINEERS BY THE PHOTOGRAPHIC METHOD.

THE following translation of a communication, presented to the French Academy of Sciences at a recent session by M. Laussedat, may be read with increased interest, in view of the rapid making of history in the distant Orient, and the sudden discovery of the immense and unexpected progress already accomplished by Russia in the development of her railway system.

I have the honor to make known to the Academy the remarkable results secured by the Russian engineers by applying the photographic method to the study of the ground in the preliminary work of the trans-Baikal and trans-Caucasian Railways.

I have the information from Richard Thilé, the engineer-in-chief.

The first of the two expeditions was undertaken in 1897. On May 1, of that year, two companies, each comprising an engineer, two students of the School of Ways of Communication as assistants and a photographer set out from St. Petersburg for the trans-Baikal region. M. Thilé directed one, and his colleague, M. Ichtschouroff, the other. There was a mechanician with them, charged with the care and repair of the instruments.

After a journey, of which more than 2,000 versts was over abominable roads, the two companies reached Oustja-Ononn, and proceeded thence, prosecuting their operations along the river Argonne, to the Chinese frontier.

From July 21 to August 26 they effected a triangulation between points 130 versts apart, measuring several bases, and taking 96 panoramic views, with eight copies of each. On August 15 the four engineer pupils, sufficiently instructed, returned to St. Petersburg, and M. Ichtschouroff, with one of the photographers, proceeded again to the station of Oustja-Ononn, in order to work out the triangulation and develop more at ease 600 of the negatives, which could not well be developed on the route on account of the frequent changes of position.

On September 7, attended by the mechanician and provided with tests, M. Thilé left the post of Klontschewskoy to undertake the study of a new line of 125 versts in length running along the frontier of China; then, turning back, he studied a variant of 38 versts, commencing not far from the station of Nagadan.

These last surveys, comprising the measure of four bases, the triangulation, and 83 photographic panoramas were accomplished in four weeks, from which six days must be deducted, on account of a fire occurring on the steppe and a violent snow storm of three days.

On returning to the railway offices at Irkoutsk, the two engineers, with the aid of 800 photographs, constructed a rough draught on the scale of $\frac{1}{1\,680\,000}$ of the region surveyed, on which were traced water courses, valleys, etc., over an extent of 3,000 square versts, with levels averaging five Russian furlongs, 10·67 meters, calculated from points of which the altitudes were well determined.

This draught was afterward employed for laying out the railway lines.

The expedition quitted Irkoutsk on December 12 and returned to St. Petersburg, where the final mapping was executed, still on the scale of $\frac{1}{1\,680\,000}$.

The work was completed, and the draughts and maps communicated to Prince Hilkoff, Privy Councilor, and Minister of the Department of Public Works and Railways, on June 1, 1898.

Thus, in less than a year, and in a country particularly inhospitable, they had succeeded in surveying with sufficient accuracy an extent of territory of 3,000 square versts, 130 versts in length, with an average of 23 versts in width.

M. Thilé adds that, including the expenses of travel, the salaries of the personnel, and even the price of the instruments, the square versts of this survey cost only ten roubles, while the square versts with the planchette cost thirty roubles; and that it must not be forgotten that by employing the former method, the hundreds of photographs which served for mapping have become so many authentic documents, full of interest in themselves and verifying accuracy.

In July, 1898, MM. Thilé and Ichtschouroff repaired to trans-Caucasia to study the routes for the railways from Tiflis to Kars and to Erivan, and from Erivan to Djoulfa, in a very mountainous country, extending their work to the frontier of Persia by the great defile of Bambuk (Tiflio-Kars) and the small defile of Alindja-Tschai.

At the present time (Spring, 1900), and since the close of the last year, the photographic work is pursued

in the trans-Caucasus and on the projected electric line between Novorossisk and Touapse on the border of the Black Sea. Finally, it has been undertaken in different directions from the Persian frontier to Teheran and from this capital to the Persian Gulf.

I will not enter into details of the excellent photographic processes, nor of the instruments employed by M. Thilé, who had only to choose from the numerous photo-theodolites to be found at various points in Europe. He decided on the models proposed by the Italian engineer Paganini Pio, one of the oldest and most distinguished experts of the photographic method.

For the great plains to be explored between Teheran and the Persian Gulf, which are less readily worked than the mountainous districts by the ordinary processes, M. Thilé has constructed a very ingenious panoramic apparatus, composed of several dark connected chambers, intending to turn to account the ideas of our fellow-countrymen, MM. Arthur Batut and Emile Wenz, by raising kites, prepared at the aerostatic park at St. Petersburg, to a suitable height for dominating the land thoroughly.

We cannot but hope that these endeavors will be attended with the signal success already achieved in trans-Baikalia and trans-Caucasia.

THE REACTION BREAKWATER AS PROPOSED FOR THE OPENING OF THE SOUTHWEST PASS OF THE MISSISSIPPI RIVER.

By LEWIS M. HAUPT, Member of Franklin Institute.

INTRODUCTORY.

THE Louisiana purchase of 1803 had for one of its objects the control of the outlet of the great central basin containing over 15,000 miles of navigable waterways, at a time when railroads were unknown.

Since 1837 the Government has made numerous desultory efforts to increase the depths at the delta mouths, which ranged from 8 to 15 feet, but without permanent results.

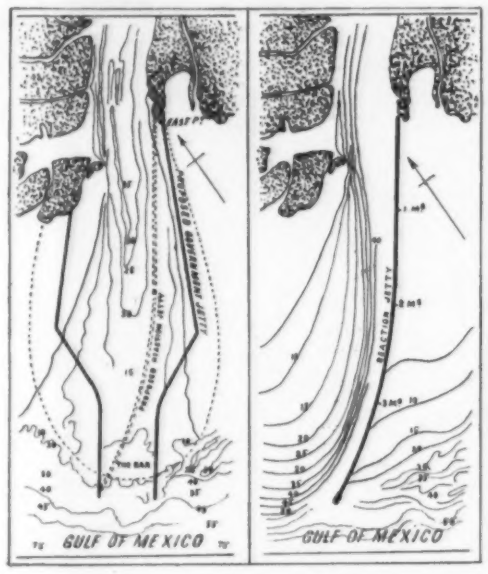
On May 3, 1875, after a protracted debate, Congress determined to depart from its usual policy and awarded a contract for the deepening of the South Pass to Capt. James B. Eads for $5,250,000, on the condition of making payments only as results were secured. After overcoming many difficulties in the face of persistent opposition, he secured a channel of 26 feet navigable depth and 700 feet surface width, which has been maintained to the present time, but this contract having now expired by limitation, and the dimensions of vessels having outgrown the channel, the problem of providing additional facilities is now demanding immediate and careful investigation.

On January 7, 1899, a Board of Engineers reported that "The following project, if executed with vigor, will, in the opinion of the Board, secure a navigable channel of adequate width and of 35 feet depth at mean low water of the Gulf of Mexico, throughout the Southwest Pass of the Mississippi River, at a cost which is not excessive considering the vast commercial interests involved, and therefore in the opinion of the Board the proposed improvement is practicable."

Briefly, the plan consisted of two parallel straight jetties placed 2,400 feet apart, to extend from "about 30 feet of water" on the outer slope of the bar for about seven miles up the pass, making over fourteen miles of jetties in all, which with the levees, sills and auxiliary works were estimated to cost $13,000,000, while the estimate for jetty extension and maintenance was $300,000 annually, equivalent to another $13,000,000 at 3 per cent. In closing this report the Board remarks that "The plans described, therefore, are such as have been selected for the purpose of estimate, and should not necessarily be strictly adhered to unless experience shall fully justify them." "It is desirable that at least two powerful dredges be constructed at the beginning of the work, for use in forming and maintaining the required channel."

These plans, which were, therefore, regarded as merely tentative and designed mainly as a basis for an estimate, were referred back by Congress to a board of four engineers, "of whom at least two shall be from civil life; . . . said board of engineers shall submit detailed estimates of the cost of each and every feature of the project, and they shall report especially whether it is necessary to construct inner jetties; and if, in their judgment, inner jetties should be constructed, they shall provide for the location of the same, so as to involve the least cost consistent with the safety and efficiency of the work hereby contemplated."*

This Board reported January 11, 1900, a radically different plan, "placing the main reliance upon dredging," and depending upon a "bottle or coffin-shaped" plan of jetties to aid in maintaining the channel. These jetties are to be divergent from the ends of the fast land, to be placed in shallow water remote from the channel, and to extend only to the outer 20-foot curve, all "for ease and cheapness of construction." "Their distance apart between centers varies from about 7,000 feet to a minimum of 3,000 feet. This width, even where it is least, is greater than has been heretofore



THE GOVERNMENT JETTY AND THE REACTION JETTY PROPOSED BY PROF. HAUPT.

deemed advisable . . . to take from them the duty of forming the channel."

In short, it would appear that the jetties will act to impound the silt in the vicinity of the channel instead of operating as a barrier to prevent its return after being pumped over, and are of no other use. Moreover, it seems that no consideration was given in this report to the quantity of silt the dredges would be obliged to handle, although it is stated that to create the desired channel would require the removal of some 22,000,000 cubic yards from the bar, and that two dredges could do this work in two or three years at a cost not exceeding 4 cents per cubic yard.† It was stated that the purpose of the modifications made in this second report was mainly to reduce the cost. The report, therefore, closes with the same recommendations as its predecessor, reserving the letting of the superstructure "until experiment and experience have developed the most economical means of construction."

It would, therefore, seem that the problem is one that demands early consideration, and a solution which will give reasonable assurance of results within a cost which shall be fully justified.

THE PHYSICAL PROBLEM.*

The possibility of securing and maintaining a deep-water channel at this pass can best be answered by a study of the work done by the stream itself under its normal conditions, regarding it as an endless belt charged with sediment.

If the favorable conditions existing in the past can be reproduced on the bar in such a manner as to create erosion instead of sedimentation and cause the deposition of the silt in a zone remote from the channel, the problem is solved in the best manner by utilizing natural agencies to carry its silt out of the pathway of navigation.

The usual method of improving the mouths of sedimentary rivers consists of the construction of two parallel jetties, at suitable distances apart, to confine the effluent until it reaches deep water on the outer slope of the bar. Such a method is effective, but it has the serious objection of recreating conditions at its mouth similar to those existing in a state of nature. The two jetties, acting as an aqueduct, must transport all the river sediment through the canalized channel and dump it in the sea at its mouth, trusting to the external forces to distribute it. This requires constant attention and dredging unless there be a strong littoral movement. Straight parallel jetties do not concentrate currents.

The modification proposed by the writer consists of a single curved jetty so located as to produce a reaction and scour across the entire bar in such a manner as to effect a lateral displacement of the material and the disposition of this silt on the opposite bank of the channel, where it will form a natural levee automatically adjusted to the regimen of the stream.

The probability of the success of this system can best be seen after a consideration of the physical condition of the stream and a careful calibration of the bar and channel.

PHYSICAL—THE BAR.

The form of the crest of the bar is an elongated ellipse having a semi-transverse axis of 3·5 miles and a conjugate axis of 1·9 miles.

Its total perimeter from East Point around to the opposite bank is 7 miles.

The width of the bar between the 35 foot contours in the river and gulf is slightly over 3 miles and the ruling minimum depth of water is about 10 feet, extending over a length of nearly 2 miles measured along the crest.

PROFILE AND SLOPES OF BAR.

From a depth exceeding 40 feet, the bed rises 14 feet, in less than 1 mile, or 1 foot on 360, thence it flattens in the next 2 miles to 1 on 690, running nearly level for several thousand feet and suddenly dropping off with an outer slope of about 1 on 12 to the 35-foot contour. Thence it deepens rapidly to over 70 feet within a half mile.

This profile is characteristic of a delta bar rolled seaward by a sedimentary river. All the material passing over it must first be dragged up the inner slope by friction or be carried in suspension by the ebb stream. With the bar removed the resistance to the transportation of sediment would be greatly reduced, and if a lateral instead of a longitudinal movement be imparted to it, the path will also be shortened and the work required of the current be still further diminished. In short, the bar would be rolled over laterally instead of being pushed out into the gulf in front of the jetties.

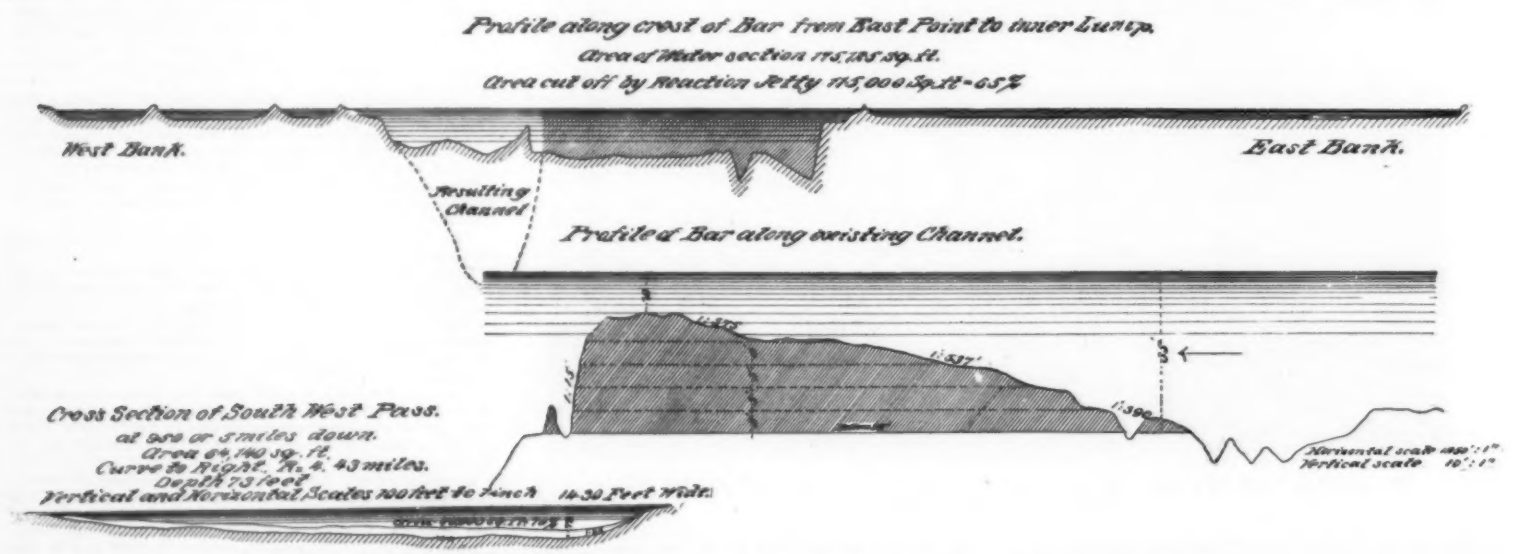
The longitudinal area of the profile of the bar above 35 feet depth, as it existed in 1898, was 265,375 square feet.

The length at bottom was about 16,700 feet, so that the mean depth of the deposit above 35 feet was 16 feet.

HYDROGRAPHY OF THE STREAM.

From the head of the pass to the outer 35-foot contour the distance is 19½ miles, of which about 15 miles are enclosed between two nearly parallel but low banks built by deposits from the stream. Beyond this point the process of bank-building is constantly progressing, but it is moulded and resisted by the exterior forces of tides, waves, winds and currents.

It should be noted, as the measure of the depths that the energy of the stream can maintain throughout the first 12 miles, that there is nowhere less than 45 feet along the thalweg of the channel, with occasional depths of 93 and 100 feet, while the mean cross-section between the first and eleventh mile is about 66,000 square feet and the average width is 1,511 feet, giving a mean depth of approximately 44 feet.


Profile along crest of Bar from East Point to inner Limit.
Area of Water section 175,185 Sq. ft.
Area cut off by Reaction Jetty 115,000 Sq. ft - 65%
West Bank.
East Bank.
Resulting Channel
Profile of Bar along existing Channel.
Cross Section of South West Pass.
at 8.8 or 5 miles down.
Area 64,140 Sq. ft.
Curve to Right. R. 4. 43 miles.
Depth 73 feet
Vertical and Horizontal Scales 100 feet to Inch
1430 Feet Wide
Horizontal scale
Vertical scale

PROFILES OF THE BAR AT THE MOUTH OF THE SOUTHWEST PASS OF MISSISSIPPI RIVER.

The quantity of discharge varies greatly at different seasons of the year, being greater in the spring; but taking the average at 200,000 cubic feet per second flowing through the mean cross-section, there will result a velocity of 3 feet per second (2 miles per hour), which is sufficient to move small stones of nearly 2 inches in diameter. It will not, therefore, permit deposits of sand or mud, and is amply sufficient to maintain the sectional area.

The observed velocities varied from about 4·9 feet in

*River and Harbor Act, March 3, 1899.

† Vide p. 4. 56 Cong., 1st Sess., H. R. Doc. 329.

* Based upon the data furnished by the survey of J. A. Ockerson, C.E., member Mississippi River Commission, 1898.

May to 1 foot in August, when the discharge was least. It is also found that 41 per cent. of the entire discharge traverses the Southwest Pass; 9 per cent. the South Pass, and the balance, or 50 per cent., the Pass à Loutre. But this 41 per cent., on reaching the gulf, where it is unconfined by restraining banks, expands externally and escapes over the bar through a section of 175,125 square feet, resulting in a mean velocity of a little more than 1 foot per second, with much lower bottom velocities. The mean depth, if uniformly distributed, would be 8·1 feet, but in consequence of the concentration due to inertia the actual depths at the apex of the bar are about 10 feet and on the flanks from zero to 3 feet. The width here is about seven times the normal width of the stream and no plan of improvement can be expected to permanently maintain the depths which does not provide for the approximate restoration and maintenance of this normal width and section.

If the width is materially enlarged it must be at the expense of depth, or the velocity will be greatly reduced and, in consequence, the rate of shoaling will be largely augmented by the effort of the stream to repair the violence done to its regimen.

THE ALIGNMENT.

But there are other agencies at work in the stream than mere volume and velocity which tend to create and maintain depths, as may be seen by a critical study of the location of the line of greatest depth with reference to the alignment of the axis of the river's bed, which have not received the attention their importance merits.

Thus, starting at the head of the pass, the river is practically straight for over 3 miles, with maximum depths diminishing, notwithstanding the contracting banks, from 76 to 58 feet. It then enters a curve to the right having a radius of 4·4 miles, which it follows for 2 miles, with depths increasing to 73 feet. Then comes a short straight reach of 4,000 feet, with depth decreasing to 69 feet, followed by a sharper curve to the left (nearly 3-mile radius), resulting in 91 feet depth at end of the seventh mile and a reverse curve to the right, of 5¼ miles radius, reaching over nearly 2 miles with 75 feet depths.

From this ninth mile the course is nearly straight to the bar, with widening banks and diminishing depths as follows: at the beginning of the tenth mile, 68 feet; eleventh, 57; twelfth, 52; thirteenth, 43; fourteenth, 36; fifteenth, 32; sixteenth, 38; seventeenth, 31; eighteenth, 21; at the end of the eighteenth mile, 15; eighteen and three-fourths crest of bar, 10; beginning of nineteenth, 15; of twentieth, 35; and of twenty-first, 93 feet.

Showing very conclusively the beneficial effects of curvature upon depth and maintenance of a channel of ample dimensions for navigation. The deepest water is found to be confined to the concavities in every instance, while even the crossings at points of inflection are not materially shoaled.

Hence it follows as a natural sequence that if, instead of permitting the effluent stream to discharge itself through a cross-section of 175,125 square feet, it be confined to one of about 70,000 or less, while at the same time the collateral bank is left open, as a weir, for surplus discharge, and if the reactionary forces be developed by a curve of normal radius, the results should be a reproduction of those existing in the stream above the bar and at a cost much less than that required to erect parallel or other jetties.

Some idea of the enormous force which would be utilized by such a jetty may be ascertained from the following figures:

The main discharge is taken, as a basis of computation, at 200,000 cubic feet per second. The area of discharge along the bar crest is 175,000 square feet. Of this, the single jetty would cut out 115,000 square feet or 66 per cent. (See cut.) If, therefore, this percentage of the discharge be deflected from its natural egress and be confined to the immediate vicinity of the guiding jetty, it would represent 133,000 cubic feet of water, weighing 3,700 gross tons, sweeping along the face of the work at the rate of 1 foot every second, in addition to the 66,000 cubic feet, or 1,850 tons already traversing this same area.

This result would only be true, theoretically, if the velocities through every unit of the cross-section were uniform, which is not the case in practice; yet it is approximately correct, and serves to illustrate the great increment in concentration and discharge over a limited path which must result from this form of construction.

In other words, if, instead of only one-third, the entire discharge be voided over a limited sector of the bar, there must result a threefold increase in velocity or a triple increase in the water section across that region of the bar.

The first result would be an increase of velocity, and the second the gradual enlargement of the section as its consequence; but these results would follow the development of the work as it proceeded, and hence there would be a rapid and simultaneous improvement depending upon the rapidity of construction, for as the resultant velocity increases by contraction due to the jetty extension, the section will be enlarged by scour due to this increase and localization of currents, thus tending to restore the velocity to its normal condition, and these agencies will operate simultaneously to create and maintain a normal cross-section and velocity after the completion of the work. The more quickly it is completed, however, the more economical and rapid will be the formation of the new channel.

As previously stated, every river possesses within itself both constructive and destructive forces; constructive where its energy is dissipated, destructive where it is concentrated.

It is for the engineer to use the one and reject the other according as he desires erosion or deposit, channel or bar.

Concentration of energy is caused by compression of currents; dissipation, by expansion.

Two parallel jetties do not compress, but merely train and direct the given quantity of water entering at their head.

A single concave curved jetty, so placed as to encroach gradually upon the path of a stream, however, does produce a compression causing reaction, deflection and deep erosion creating a channel parallel to its axis and building a natural levee by the lateral transportation of the displaced material.

If properly adjusted to a sedimentary delta bar, it converts dispersion into concentration, confining the energy of the outflow to the weakest section of the bar and produces a change of equilibrium in favor of the effluent stream. In short, it flanks the bar and opens the port.

Thus, this available energy of the stream, instead of being ignored, may be trained and applied to the carving out and maintenance of its own ample waterway for the benefit of commerce and industry.

INFLUENCE OF CURVATURE UPON DEPTH.

Every pilot and navigator understands that the deep-water channel hugs the concave bank, and every physical hydrographer has observed the same fact, while the engineering profession has been slow to recognize its cause or to make any practical application of this potent agent in the removal of shoals or the creation of channels.

Having in view their application, a few physical facts may be stated as fundamental principles:

1. Rivers ignore straight lines and abrupt or angular changes of direction.

2. The bed of the channel does not mould the stream, which is the living entity, so much as the stream moulds the channel, though they are closely related. The stream is the force, the bed the resistance as well as the resultant of that force.

3. Bars are not found in the concavities of the bends; hence, if a stream is made to bend over a bar, the latter must disappear.

4. Neither velocity nor volume constitute the most important factors in erosion, but the impact due to concentrating currents, continuously supported, or, in other words, a constantly maintained change of direction, causing reaction accompanied by lateral and vertical movements.

These agencies and effects have been carefully observed and studied of late years by some of the most distinguished and successful hydraulicians of Europe. A few of the conclusions reached by these authorities will be found in the appendix, as confirming these principles.

THE PROPOSED PLAN.

The jetty which will best fulfil the requirements of this problem is the one starting from East Point and extending nearly 2 miles in almost a straight line parallel with the axis of flow and at a proper distance from it, thence curving to the westward with a radius of about 4·64 miles for a little more than 2 miles and ending at the 30-foot outer contour.

The portion of the area of discharge which would be cut out by this jetty is 115,750 square feet, or 66 per cent., which deducted from the total area would leave 59,375 square feet or less than the normal section, but as the work would require several years to build and the volume of the movement would be confined to the outflow following the line of the jetty, the formation of the channel would be local, permanent, and rapid. The 15,000 square feet of water section on the west flats would ultimately partially fill up and thus assist in confining the currents to the channel.

It is not the purpose of this paper to consider the details nor cost of construction.

BAR ADVANCE.

The comparative surveys since 1838 and 1898 show that during these sixty years the outer "35-foot" contour has moved gulfward about 3 miles, giving an average rate of 259 feet per annum, although the rate during the last quarter century was but ¾ of a mile or 176 feet per annum. The building of parallel jetties confining the slit to the outer slope of the bar would undoubtedly greatly increase this advance; the bottle-shaped plan would create two bars, one outer and one inner, while the single-curved jetty which would deflect material laterally over the ample shoals of the westward would retard it; but assuming that it were to advance at the rate of 100 feet per annum, it would require over fifty years to travel 1 mile, and the plan of the jetty is such that it would reach 7·4 miles before covering a quadrant, while, if found necessary, a tangent or reversal of curvature can be introduced in the distant future, as in the pass above, if thought desirable by remote generations.

DREDGING.

In this interesting review of the history of operations at the mouth of the Mississippi, Major Jas. B. Quinn, U. S. E., states that the first efforts consisted in stirring up the bottom with harrows, which were moderately successful in securing a slight increase. Then jetties were combined with the stirring-up process. This failed. The necessities for commerce grew, and yet with powerful dredging machines the maintenance of a channel with as little as 20 feet depth was ineffective. Surveys were made, boards reported, theories were fiercely debated, but they all ended in recommending larger appropriations.

Then came Captain Eads, and threw himself into the breach. He was most bitterly opposed by those who should have given him greatest encouragement. He risked his life and fortune, and finally opened a channel 30 feet in depth, disproving the ominous predictions of disaster and rapid bar advance by his success. "His perseverance under such adverse circumstances (says Major Quinn) was truly remarkable."

The first effort to open the Southwest Pass was made in 1837, by using an ordinary bucket drag. No improvement resulted, as a single storm obliterated all traces of the channel.

In 1852 $75,000 were appropriated to be expended by a Board of Army and Navy Engineers, who recommended the stirring-up process, and a contract was made for a channel 18 feet deep and 300 feet wide. This channel was maintained by harrowing and dredging for a whole year.

No further appropriations being made until 1856, the 18-foot channel vanished. Then $330,000 were made available. The contractors secured and maintained an 18-foot channel only so long as operations continued.

In 1867 another contract for stirring up was made for $75,000, but not executed. Then the "Government built a powerful dredge boat of special design, which was operated under the very best conditions," but it did not succeed in maintaining a much deeper channel than that formerly secured.

"Everybody was tired of the uncertain results secured by dredging on the bars," and the fort St. Philip Ship Canal was proposed and estimated to cost $10,273,000. The only officer opposing it was Col. J. G. Barnard, U. S. E., who advocated an open-mouthed river.

Mr. Eads proposed to improve the Southwest Pass by jetties for $10,000,000. Ultimate depth, 28 feet. This led to a fierce controversy, resulting in Eads being required to accept the South Pass at a cost of $5,250,000.

The report of the Board, submitted January 13, 1875, recommended parallel dikes, with a view of obtaining a navigable channel of 25 feet, at an estimated cost for the South Pass of $7,942,110 and for the Southwest Pass of $16,053,124.

The Board, therefore, recommended the South Pass as being entirely adequate and much cheaper. It stated;

"Its depth is 7 feet, and it discharges at its mouth about 22,000,000 cubic yards of sediment in suspension per annum," and added,

"These jetties should be 900 feet apart and run in straight lines parallel to each other to the 30 feet depth outside."

Fortunately, they were not built straight, but on a curve, gradually compounding to the westward, and ultimately still further contracted by spur dikes to reduce the width to about 700 feet.

The east jetty as built was 2½ miles long, and had a radius at the outer end of a little over 2 miles (11,720 feet). The west jetty was about 1,000 feet distant, and had a radius of 15,000 feet.

The above digression will illustrate the difference between what was recommended and what was done, and serves to fill out the history.

Returning to the sediment and its removal by dredging, there is considerable range of opinion as to the amount of silt carried to the gulf through all the passes, but an average of the various statements made gives about 255,000,000 cubic yards per annum. This divided in the proportion of the flow through the mouths gives:

	Cubic Yards.
For the South Pass	22,500,000
" " Southwest Pass	102,500,009
" " Pass à Loutre	125,000,000

Any plan, therefore, which bottles up the natural escape for this enormous amount of sediment by two jetties and proposes to place its main reliance upon a dredging plant having a capacity much less than the annual sedimentation, must involve a herculean task, and would seem, in view of all past experiences, to be an interminable and enormously expensive problem.

On the contrary, the utilization of the energy of the stream by the interposition on the bar of a concave but stable resistance which leaves the right bank open for a natural adjustment of the regimen would appear to furnish the most economical and expeditious solution. It should be remembered also that the cross-section of the stream is more than double that required for navigation, so that if the new channel developed only 50 per cent. of the present section in the pass, it would still be more than sufficient.

CONCLUSIONS.

It would, therefore, seem to be a wise and rational policy to control the effluent stream at the Southwest Pass by a single training wall or jetty curving gently to the westward and reducing the area of discharge to that of the normal section with resulting mean depths of over 40 feet, permitting the river to build its own counter-levee and to adjust its regimen to the new conditions without material advance of the bar seaward.

APPENDIX.

In his paper on "River Currents and Configuration of River Beds," read at the Hague International Navigation Congress of 1894, the author, L. Léliavski, a distinguished Russian engineer, said in substance:

"Parallel or nearly parallel dikes look very well on the plan, but are in reality not applicable, as the idea on which they are based is in contradiction to the laws of movements of currents in river."

In works so constructed the channel is arbitrary and temporary, and often the reverse of what it should be.

There is no formula yet applicable to practice. The directions of water threads in a river are not parallel.

"As the curves of the bed are stronger the more remarkable is the depth produced by a great pressure of water on the bottom caused by a convergence of the water threads toward the concave banks.

"Deepening increases not with the velocity of the current, but rather with the head of water working on the deepening and especially at an increased depth. The water, by its weight, does not allow the lower strata to pass over the irregularities of the bottom, but carries them away."

In the expression

$$\frac{M}{2}(v^2 - v_1^2)$$

much depends on the difference of velocity before and after impact; between v and v_1. If the obstruction be large and the current narrow, ten $v - v_1$ is large and a considerable part of the mechanical power of the water is expended on the body to cause its removal.

"Therefore, to obtain the greatest difference of $v - v_1$, the radii of curves must be shortened.

"In projecting the trace of the banks we must principally follow the configurations of natural concave banks.

"Mere narrowing is not sufficient to remove 'crossings'; the threads must be made to take 'always a convergent direction,' thus increasing v and M and diminishing v_1.

"All the molecules of a liquid body, having different velocities, described curved lines, not parallel and not concentric.

"The head of water in the concave bank, by its pressure, causes the water to flow at the bottom in the inverse direction and obliquely to the banks.

"Material loosened in concavities is carried by the undercurrents, which distribute it in the direction of the opposite convex banks.

"The current converging toward a concave bank engenders by its shock an undercurrent in a direction lateral to the surface.

"The currents of the rapid channel draw the more

sluggish threads toward it. In this way the threads arrive at the concave banks by the force of inertia, and partly also by the result of centrifugal force.

"The currents are not due to the form of the cross-section, but, on the contrary, the formation of the profile of the bed arises exclusively from the influence of their currents.

"The converging current causes longitudinal cavities, which are especially deep in the curves, and the bottom current rejects the soil from the sloping banks.

"The sharper the curve of the concave bank, the more rapid is the descent of the particle (of water) from the upper beds to the bottom, the greater is the power acquired by the movement and the greater the excavation of the bottom. The depth, therefore, varies inversely as the radius of the curve.

"The depth and constancy of the navigable channel are the effect of the converging currents. There must be room for the equal divergence of the bottom currents to admit of free circulation.

"There is no converging current at the inflections of the bed; there are, so to speak, not even banks.

"In order to have a considerable and stable deepening of the bed it is necessary to give the concave bank a regular form and a sufficient curve, and by an artificial lengthening to conduct the water across to the concavity of the next reach, which has to be treated in the same manner. With this treatment the inflections (crossing bars) of the bed disappear and we obtain banks alternately concave on each side. These banks may be designated conductors of the converging water threads and of the channel."

At this same Congress, Messrs. Mengin, Lecreulx and Guiard reported their observations of similar phenomena. They say:

"Only observation of fact is of any real value.

"It is long known that concave banks produce deep pools, and all variations in curves of banks give rise to correspondiug variations in depth, clearly shown on the Garronne River. A general formula for the relation can hardly be stated for width, depth, speed, material.

"A local increase in width causes a shoal, although upon this same shoal the speed remains great and the bottom is unstable.

"If, abandoning the rectilinear form of bed, we introduce curves, the continuity of these curves becomes extremely important."

Thus these experienced practitioners would seem to confirm in every particular the principles and practice upon which the single reactionary breakwater is based. —Journal of the Franklin Institute.

AN IDEA OF CHINA'S MILLIONS.

A COMPARISON between the population of the Chinese provinces and the population of equal areas in the United States, which has been going the rounds of the press recently, gives a vivid idea of how dense the population is in that country where the soil yields four crops every year. In the closest comparison, that between Kweichow and the States of Virginia and West Virginia, it will be seen that the disparity is more than 3 to 1, while in the case of Kwantung and Kansas the ratio rises as high as 21 to 1. One thinks of New England, New York, Ohio, Illinois, and other States as thickly settled until a comparison with China makes them appear rural. Here are the figures.

	Area (square miles).	Population.
Hupeh	70,450	33,365,005
Ohio and Indiana	76,670	5,864,720
Honan	65,104	22,115,827
Missouri	68,735	2,679,184
Chehkiang	39,150	11,588,692
Kentucky	40,000	1,858,635
Kiangsi	72,176	24,534,118
Kentucky and Tennessee	81,750	3,626,252
Kweichow	64,554	7,669,181
Virginia and West Virginia	64,770	2,418,774
Yunnan	107,969	11,721,576
Michigan and Wisconsin	111,880	3,780,769
Fuhkien	38,480	23,000,000
Ohio	40,760	3,672,316
Chihli	58,949	17,937,000
Georgia	50,980	1,837,358
Shantung	65,104	36,248,000
New England	62,000	4,700,945
Shansi	56,268	12,211,453
Illinois	56,000	3,826,851
Shensi	67,400	8,432,193
Nebraska	76,840	1,058,910
Kansuh	125,450	9,285,377
California	155,980	1,208,130
Szechuan	166,800	67,712,897
Ohio, Indiana, Illinois, and Kentucky	173,430	11,350,209
Ngan Hwuy	48,461	20,596,288
New York	47,620	5,997,853
Kiangsu	44,500	20,905,171
Pennsylvania	44,985	5,258,014
Kwantung	79,456	29,706,240
Kansas	81,700	1,427,096
Kwangsi	78,250	5,151,327
Minnesota	79,305	1,301,826
Chingkiang	43,000	6,000,000
Louisiana	45,000	1,110,569

The population of the United States as a whole is about 20 persons per square mile. The population of the Chinese Empire is about 300 per square mile.

New German-American Cable.—Consul Hughes reports from Coburg, June 23, 1900:

On April 2, Germany commenced laying the Emden-New York cable via the Azores. The Emden-Borkum section is partly on land; from the island of Borkum it is an all-sea cable. The cable will have a length of 8,020 kilometers (4,984 miles), and will, altogether, cost very nearly £1,000,000 ($4,866,500). It is hoped to complete the task during this summer, so that the new cable may be opened by October next.

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TABLE OF CONTENTS.

	PAGE
I. AERIAL NAVIGATION.—French Aerial Navigation	20604
II. CIVIL ENGINEERING.—New Waterwork Extension in Glasgow.—3 illustrations	20601
Surveying and Reconnoitering Work of the Russian Engineers by the Photographic Method	20603
The Reaction Breakwater as Proposed for the Opening of the Southwest Pass of the Mississippi River.—2 illustrations	20604
III. COMMERCE.—Some of the Resources of the Philippines.—By G. D. RICE	20601
Trade Suggestions from United States Consuls	20607
IV. ELECTRICITY.—Advancement of Electrical Chemistry.—1 illustration	20600
V. EXPOSITIONS.—The Pavilion of Great Britain at the Paris Exposition.—1 illustration	20605
VI. FOOD.—Banana Flour	20601
VII. MECHANICAL ENGINEERING.—The Weighing of Locomotives.—2 illustrations	20604
VIII. METALLURGY.—Iron and Steel Rails in America.—By ROBERT W. HUNT	20602
IX. MINING.—American Engineering Competition.—V.—Ore Supplies and Transport	20603
X. MISCELLANEOUS.—An Idea of China's Millions	20606
Tourists in Switzerland	20600
Valueless Printed Matter	20601
Trade Notes and Receipts	20606
Selected Formulæ	20606
XI. OILS.—American Petroleum.—1 illustration	20604
XII. PANORAMAS.—The Panoramas of the Exposition of 1900.—5 illustrations	20602
XIII. PHARMACY.—How Quinine is Raised	20602
Production of Ipecacuanha	20606
XIV. PHOTOGRAPHY.—Desiccated Dry Plates	20603
XV. TEXTILES.—The Flax Industry of Courtrai	20602
XVI. TRAVEL AND EXPLORATION.—Persia and its Capital City.—7 illustrations	20598
The Borchgrevink-Newnes Expedition	20598

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